VOLUME III: REMEDIAL INVESTIGATION WORK PLAN

FOR

THE MARINE ENVIRONMENT NEAR THE FORMER RAYONIER PULP MILL

Port Angeles, Washington

Prepared for

Rayonier, Inc.
Jacksonville, Florida

Prepared by

FOSTER WHEELER

FOSTER WHEELER ENVIRONMENTAL CORPORATION

12100 NE 195th Street
Bothell, WA 98011

July 2002

This page left intentionally blank.

CONTENTS

CONTENTS (continued)

CONTENTS (continued)

CONTENTS (continued)

FIGURES

TABLES

ACRONYMS AND ABBREVIATIONS

ARAR	applicable, relevant, and appropriate requirement
ASTM	American Society for Testing and Materials
AVS	Acid Volatile Sulfides
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
COPC	contaminant of potential concern
DOT	U.S. Department of Transportation
DQO	Data Quality Objective
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
EQL	estimated quantitation limit
ESI	Expanded Site Inspection
FCR	Field Change Request
FOL	Field Operations Lead
GPS	Global Positioning System
GRO	gasoline range organics
LIMS	Laboratory Information Management Systems
MDL	Method Detection Limit
MTCA	Model Toxics Control Act
NCASI	National Council of the Paper Industry for Air and Stream Improvement
NCR	Nonconformance Report
NIST	National Institute of Standards and Testing
NPL	National Priorities List
PAH	polynuclear aromatic hydrocarbon
PARCC	precision, accuracy, representativeness, completeness, and comparability
PCB	polychlorinated biphenyl
PE	Performance Evaluation
PHSM	Project Health and Safety Manager
PQL	Practical Quantitation Limit
PSEP	Puget Sound Estuary Program
QA	Quality Assurance

ACRONYMS AND ABBREVIATIONS (continued)

QAPP	Quality Assurance Project Plan
QC	Quality Control
RBCA	risk-based corrective action
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SHSO	Site Health and Safety Officer
SMT	Site Management Team
SMS	sediment management standards
SOP	Standard Operating Procedure
SRPM	Site Remediation Project Manager
TOC	total organic carbon
Tribe	Lower Elwha Klallam Tribe
TSS	total suspended solids
TVS	total volatile solids
VOC	volatile organic compound
WAC	Washington Administrative Code
WEF	Water Environment Federation

GLOSSARY

Accuracy—The agreement between a reported result and the true value.

Action Limit—A value for results of a QC analysis that requires appropriate action to be taken to correct the performance of a system or a method that is not in control. Action limits and appropriate corrective actions are specified contractually. Data obtained when a system or method is not in control may be omitted from a regional database. Note: in a multianalyte method, failure to meet the calibration requirement for a small percentage of analytes should not be cause to omit the entire analysis for a sample from the database. Omission should be determined on an analyte by analyte basis. Action limits and appropriate corrective actions are specified contractually.

Analyte—That which is identified and quantified in the process of analyzing the sample.

Assessment—The evaluation process used to measure the performance or compliance of sampling and analysis activities.

Audit—A systematic and independent examination to determine whether sampling and analysis activities and related results comply with planned practices, whether these practices are implemented effectively, and whether the nature and extent of these practices are suitable for the sampling and analysis activities they support.

Batch—The number of samples that are prepared or analyzed with associated laboratory QC samples at one time. A typical batch size is 20 samples.

Bias—The systematic or persistent distortion of a measurement process which causes errors in one detection.

Blank-corrected Result—Refers to an analytical result that has been corrected (mathematically or thorough analytical procedures) for the contribution of the method blank. The method blank should be processed concurrently. Any correction should account mathematically for all relevant weights, volumes, dilutions, and other similar sample processing elements.

Calibration—The determination of the relationship between instrument response and measurement (e.g., concentration or mass of the analyte).

Certified Reference Material—A reference material accompanied by, or traceable to, a certificate stating the concentration of chemicals contained in the material. The certificate is issued by an organization, public, or private, that routinely certifies such material (e.g., National Institute of Standards and Testing [NIST], National Research Council of Canada [NRCC], Ottawa).

GLOSSARY (continued)

Chain-of-Custody—An unbroken trail of accountability that ensures the physical security of samples, data, and records.

Check Standard—A QC sample prepared independently of calibration standards, analyzed exactly like the samples, and used to estimate analytical precision and indicate bias due to calibration.

Coefficient of Variation—The standard deviation expressed as a percentage of the mean. Also termed relative standard deviation (RSD).

Comparability—An indication of the confidence with which one data set can be compared to another.

Completeness—A measure of the amount of valid data obtained from sampling and analysis activities compared to the amount that was expected to be obtained.

Conceptual Site Model—Information on the contamination, fate and transport, and receptors potentially at a site. The model is used as a tool in risk assessments to describe relationships between chemical contaminants and potentially exposed receptor organisms. The conceptual site model includes known and suspected sources of contamination, types of contaminants, affected media, known and potential routes of migration, and known or potential human and ecological receptors.

Congener—In the context of dioxins or furans, structures with the same degree (number) of chlorine atoms. For example, 1,2,3,4,7,8-Hexachloro Dibenzo Dioxin and 1,2,3,6,7,8-Hexachloro Dibenzo Dioxin are congeners.

Consent Decree—A written agreement developed by regulatory agencies and EPA to document agreed-upon assessment and cleanup measures to be applied to a site that has environmental impacts justifying state jurisdiction.

Control Limit(s)—A value or range of values against which results of QC sample analyses are compared in order to determine whether the performance of a system or method is acceptable. Control limits are typically statistically derived. When QC results exceed established control limits, appropriate corrective action should be taken to adjust the performance of the system or method.

Corrective Action—Measures taken to remove, adjust, remedy, or counteract a malfunction or error so that a standard or required condition is subsequently met.

GLOSSARY (continued)

Data Quality Objectives (DQOs)—DQOs are qualitative and quantitative statements that define the appropriate type and quality of data needed to support the objective of a given project.

Detection Limit—In analytical chemistry, a threshold concentration for a compound below which its presence cannot be measured. The threshold concentration results from a number of different influences, including interference from other compounds in the sample or the inherent limits of the measuring instrument in resolving the measurement signal.

Dioxin—A generic term, often used to describe a group of 210 structurally related halogenated aromatic hydrocarbons. These compounds are distributed between two classes, the polychlorinated dibenzodioxins and the polychlorinated dibenzofurans.

Duplicate Analysis—Analysis performed on a second subsample in the same manner as the initial analysis, used to provide an indication of measurement precision.

Exposure Pathway—The route a chemical would take through the environment from the time of its release until it reaches that point where a receptor is exposed. For example, the release of a chemical during the burning of some material could end up collecting on nearby vegetation. Rain would wash some of it off onto the ground where it might run off into a nearby pond. Fish in the pond would adsorb some through their gills and it might collect in the fish's fatty tissues. A fisherman could catch and eat the fish. The exposure to a chemical might be measured at several different places along this pathway.

Feasibility Study (FS)—An investigation or study that provides identification and evaluation of site cleanup alternatives. It stems from the Remedial Investigation (RI) process and is followed by the cleanup action plan. The FS evaluates site information and associated technology data to enable the selection of a cleanup action plan.

Field Blank—A simulated sample (usually consisting of laboratory pure water) that is taken through all phases of sample collection and analysis. Results of field blank analyses are used to assess the positive contribution from sample collection and analysis procedures to the final result.

Graphite Furnace Atomic Absorption Spectroscopy (GFAA)—A technique for metals analysis in which a sample is atomized in a graphite tube in a furnace, and the resulting vapor placed in a beam of radiation containing excited molecules of the element to be measured. Attenuation of the transmitted radiation is a measure of the concentration of that element in the sample.

GLOSSARY (continued)

Guideline—A recommended practice that is non-mandatory.

Inductively Coupled Argon Plasma Optical Emission Spectroscopy (ICP)—A technique for simultaneous or rapid sequential analysis for many elements in a short time. Element-specific atomic-emission line spectra of nebulized samples are produced by a radio frequency inductively coupled plasma.

Interference Check Sample—A sample run by ICP methodology to verify inter-element and background correction factors.

Management Plan—This is a cumulative document of various plans, including the Conceptual Site Model, SAP, SHSP, and QAPP.

Matrix—The sample material in which the analytes of interest are found (e.g., water, sediment, tissue).

Matrix Spike—A QC sample that is created by adding known amounts of analytes of interest to an actual sample, usually prior to extraction or digestion. The matrix spike is analyzed using the normal analytical procedures. The result is then corrected for the analyte concentration determined in the unspiked sample, and expressed as a percent recovery. This provides an indication of the sample matrix effect on the recovery of target analytes.

Method—A body of procedures and techniques for performing an activity that is systematically presented in the order in which they are to be executed.

Method Blank—A QC sample intended to determine the response at zero concentration of analyte and assess the positive contribution from sample analysis procedures to the final result. A clean matrix (generally water) known to be free of target analytes that is processed through the analytical procedure in the same manner as associated samples.

Method Detection Limit—The minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero; determined from analysis of a sample in a given matrix containing the element.

Normalize—Perform a data calculation in order to express results in terms of a reference parameter or characteristic.

Method Quantitation Limit—The minimum concentration of a substance that can be measured and reported. This is an earlier EPA definition, similar to MDL above.

Percent RSD—Calculated by dividing the standard deviation by the mean and multiplying by 100.

GLOSSARY (continued)

Polymer—A chemical compound or mixture of compounds formed by polymerization and consisting essentially of repeating structural units.

Practical Quantitation Limit (PQL)—The lowest level (of analyte detection) that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. Similar to estimated quantitation limit (EQL).

Precision—The statistical agreement among independent measurements determined from repeated applications of a method under specified conditions. Usually expressed as RPD, RSD, or coefficient of variation.

Qualified Data—Data to which data qualifiers have been assigned. Data qualifiers provide an indication that a performance specification in the qualified sample or an associated QC sample was not met, or that a special condition existed during the analysis of the sample.

Quality Assurance—An integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the customer.

Quality Assurance Project Plan (QAPP)—A formal planning document describing the necessary QA, QC, and other technical activities that must be implemented to ensure that the results of the work performed will satisfy the stated performance criteria.

Quality Control—The routine application of procedures for obtaining prescribed standards of performance in the monitoring and measurement process. QC is an element of QA. QC samples and auditing/assessment are common QC activities.

Quantification—The process of calculating the value of an analyte in a particular sample.

Quantification Limit Check Sample—A check sample containing target analytes at concentrations at or near the quantification limit; used to verify routing method performance at the quantification limit.

Receptor—An organism or medium that receives exposure to a toxic or harmful substance.

Recovery—The percentage difference between two measurements, before and after spiking, relative to the concentration spiked, or the percentage difference between a measured value and a true value, as in the case of a reference material or check standard.

Reference Material—A material of known analyte composition that can be used for comparison of analytical results. The reported analyte concentrations have not been certified.

GLOSSARY (continued)

Relative Percent Difference—Difference of two measurements x_1 and x_2 divided by the mean of the measurements, multiplied by 100.

Remedial Investigation (RI)—Any action that provides information on the extent and magnitude of contamination at a site. The purpose of the remedial investigation/feasibility study is to collect and develop sufficient site information enabling the selection of a cleanup action. This includes characterization of the site, risk assessment, and feasibility study.

Representativeness—A measure of the degree to which data accurately and precisely represent an environmental characteristic or condition.

Reproducibility—The ability to produce the same results for a measurement. Often measured by determining the RPD, RSD, or coefficient of variation for an analysis.

Risk—The probability of harm, including short-term and long-term effects, to human health, the ecology of the economic system, or the quality of human life.

Risk Assessment—The process by which the form, nature, extent, and characteristics of a risk are estimated. Types include human health risk assessments (impact to people) and ecological risk assessments (impact to plants and animals).

Sampling and Analysis Plan (SAP)—A plan that includes information on sampling frequency, sampling locations, sampling procedures, chain-of-custody, acceptance criteria, analytical methods, and data quality management.

Semi-volatile organic compounds (SVOCs)—Organic compounds with moderate or low vapor pressures that can be extracted from samples using organic solvents.

Site Health and Safety Plan (SHSP)—A plan to help ensure worker health and safety while conducting investigations at the site. It includes sections on protective clothing, decontamination, emergency medical information, and information on potential contaminants.

Spike—The addition of a known amount of a substance to a sample or a blank.

Spiked Method Blank—See Check Standard.

Standard—A substance of material, the properties of which are believed to be known with sufficient accuracy to permit its use to evaluate the same property of a sample. In chemical measurements, standard often describes a solution of analytes used to calibrate an instrument.

GLOSSARY (continued)

Standard Reference Material—A material with known properties produced and distributed by the U.S. National Institute of Standards and Technology (NIST) or other recognized standards organization.

Surrogate Spike Compound—A compound that has characteristics similar to that of a compound of interest is not expected to be found in environmental samples, and is added to a sample prior to extraction. The surrogate compound can be used to estimate the recovery of chemicals in the sample.

Target Analytes—(or Target Compounds)—One or more elements or compounds which are intended to be determined by an analytical procedure (often in contrast to tentatively identified compounds).

Tentatively Identified Compounds—Compounds not considered to be primarily target analytes, but which are tentatively determined during analysis. Typically associated control limits or QC are not available for these compounds, hence the tentative identification.

Toxic Equivalent Concentration (TEC or TEQ)—A calculated concentration used to represent the toxicity of a dioxin sample so that it may be easily compared with another dioxin sample containing a different combination of some of the 210 compounds in the dioxin family. The process is to assign each member of the dioxin family a value weighted to the toxicity of the most toxic member of the group, 2,3,7,8-TCDD. This compound has a value of 1, while all others are some fraction of 1.

Validation—Confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled. It can refer to a process whereby environmental data are determined by an independent entity to be complete and final (i.e., subject to no further change), and to have their value for the intended use described by both qualitative and quantitative statements.

Volatile Organic Compounds (VOCs)—Organic compounds with high vapor pressures that tend to evaporate readily from a sample.

Volatilization—The process of vaporizing at a relatively low temperature.

This page left intentionally blank.

1. PROJECT DESCRIPTION

1.1 SITE DESCRIPTION AND BACKGROUND

The project site is a former pulp mill facility located in the city of Port Angeles, Clallam County, Washington along the north coast of the Olympic Peninsula. Its physical setting includes the southern shore of Port Angeles Harbor adjacent to the Strait of Juan de Fuca. The site occupies approximately 80 acres, bounded by a high bluff and the harbor shoreline.

The area experienced historical tribal activity until the late 1800s. A sawmill was constructed at the site and briefly operated around 1917. The mill then remained idle until 1929, when Olympic Forest Products (predecessor to Rayonier) purchased the site and began construction of a pulp mill. From 1930 to 1997, Rayonier and its predecessor companies operated an ammonia-based acid sulfite process to produce dissolving-grade pulps at the site. In 1997, the mill closed, and over the past 3 years the mill was subsequently dismantled and demolished. In 1997 to 1998, the U.S. Environmental Protection Agency (EPA) conducted an Expanded Site Inspection (ESI) (EPA, 1998) as part of an evaluation for a possible listing as a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site. Further information on site details, potential chemical releases, and contamination associated with the site are found in Sections 2 and 3 of Volume I: Remedial Investigation (RI) Work Plan, and in the ESI.

1.2 HISTORICAL INFORMATION

1.2.1 History and Previous Investigations

The history of the site, including potential sources and contamination, is described in Sections 2 and 3 of Volume I: RI Work Plan and other key project documents including the Current Situation/Site Conceptual Model Report (Foster Wheeler Environmental, 1997) and the EPA ESI. The site conceptual model report summarizes the current situation by addressing the physical features, site boundaries, land usage, waste-related history, and the nature and extent of potential contamination, as it is currently understood. The site conceptual model identifies the contaminants of potential concern (COPCs), contaminant migration pathways, and the human and ecological receptors. The ESI provides a detailed account of the site history, potential contaminant sources, and a summary of historical data.

The historical data may be used to augment the site conceptual model, and further characterize the site conditions.

1.2.2 Recent Developments

In May 2000 EPA, Washington State Department of Ecology (Ecology), and the Lower Elwha Klallam Tribe (Tribe) completed a deferral agreement. Rayonier had previously agreed to conduct an RI of their former pulp mill site as part of an Ecology-led cleanup under the Model Toxics Control Act (MTCA) and to support both tribal and Ecology participation. Through the Site Remediation Project Manager (SRPM), Ecology will be the lead agency for this project. With the assistance of the Site Management Team[1] (SMT), they will determine the scope and manner of the investigations and the extent and type of remediation at the site. When the necessary response actions at the site are successfully completed, EPA will have no further interest in considering the site for listing on the National Priorities List (NPL), assuming no further significant contaminant releases occur and there is not a significant potential for release that would pose a threat to human health or the environment.

Foster Wheeler Environmental Corporation (Foster Wheeler Environmental) has been retained by Rayonier to prepare Site Management Plans to support remedial work at the former Rayonier Mill site consisting of an RI Work Plan (Volume I), a Sampling and Analysis Plan—Marine Environment (Volume II), and a Quality Assurance Project Plan (Volume III).

1.3 PROJECT OBJECTIVES

The main objectives of this RI, as defined by the field sampling program, are:

- To determine potential sources and the nature and extent of contamination in the surface and subsurface soil, surface water, groundwater, aquatic biota, water intertidal column, sediment, and benthic communities.
- To provide data to support site-specific risk assessment and evaluation of remaining risk drivers and exposure pathways.

[1] Ecology, Rayonier, and the Lower Elwha Klallam Tribe

- To provide data that will be used to help develop feasible, constructable remedial alternatives to achieve risk-based cleanup levels consistent with the applicable, relevant, and appropriate requirements (ARARs) and action levels developed for the site.
- To provide data to aid in the correction of problems identified during the remediation process.

These objectives will be accomplished using a judgment-based sampling program. The statutory provisions under MTCA, together with the deferral agreement, will provide the regulatory basis. The specific purpose of this Quality Assurance Project Plan (QAPP) is to ensure that all data collected are of sufficient quality to support these project objectives.

1.4 OBJECTIVES OF THE QUALITY ASSURANCE PROGRAM

Quality Assurance (QA) is defined as the total integrated program for ensuring reliability of monitoring and measuring data. Quality Control (QC) is defined as the routine application of procedures for obtaining prescribed standards of performance in the monitoring and measuring process.

The objectives of the QA program are to ensure: (1) the procedures used will not detract from the quality of the results; and (2) all activities, findings, and results follow the terms and conditions of this QAPP and are documented. The QAPP is based generally on Ecology and EPA guidance provided by:

- WDOE 91-16, Guidelines and Specifications for Preparing Quality Assurance Project Plans (Ecology, 1991a)
- EPA/330/9-78/001R, NEIC Policies and Procedures (EPA, 1978)
- EPA/540/6-89/004, OSWER Directive 9355.3-01, October 1988, Guidance on Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA, 1989)
- EPA/QAMS/005/80, Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans (EPA, 1980)
- EPA/540-R-93-071, Data Quality Objectives Process for Superfund, Interim Final Guidance (EPA, 1993a)

All project activities, findings, and results will follow the terms and conditions of this QAPP and will be documented accordingly. The QAPP will provide guidance for all personnel involved in plan preparation and review as well as actual project site activities. The QAPP will ensure that the project proceeds in an orderly and well-documented manner. Project-specific procedures and protocols for the experimental design, sample collection, chain-of-custody, preservation and shipment, laboratory and data analysis, and report preparation are included in this QAPP or by reference to the Sampling and Analysis Plan (SAP) that is included as part of the project submittals (Volume II: Sampling and Analysis Plan—Marine Environment).

The structure of this QAPP follows Ecology specifications (Ecology, 1991) as developed from basic EPA guidance for preparation of QAPPs—QAMS-005-80 (EPA, 1980).

Specific project activities of concern to the QA program include, but are not limited to, the following:

- Project-specific procedures and protocols described in Volumes I and II, including project QC, are reviewed and approved by the Foster Wheeler Environmental Project Manager and QA Manager, Rayonier, Ecology, and the Tribe prior to initiation of project activities.
- Project personnel receive adequate training on all project plans prior to initiation of project activities. This activity includes a requirement to read and understand all project plans prior to their implementation, and sign a statement to that effect. The QA Manager will maintain these records. Also, pre-activity briefings will be part of the daily health and safety briefing, and the Field Operations Lead (FOL) will provide oversight.
- The project proceeds in an orderly manner according to established procedures and protocols presented in Volume I: RI Work Plan for experimental design, sample collection, chain-of-custody process, sample shipment, vendor processing, laboratory and data analysis, review, and final reporting.
- Significant changes to the QAPP will be provided to the Ecology Site Remediation Project Manager with the opportunity to comment on and approve revisions.

This QAPP will be used for the RI specifically and for calculations for other areas. It is Foster Wheeler Environmental's management policy to maintain the highest standards of quality throughout all activities and operations in accordance with all applicable regulations

and standards. The Foster Wheeler Environmental Corporate Quality Assurance Program Manual represents this policy. The requirements for ensuring the highest standards of quality, as contained in the Corporate Quality Assurance Program Manual, are to be used as a standard in conjunction with this project-specific QAPP.

1.5 SAMPLING DESIGN

The overall approach for sampling design is contained in the SAP (Volume II). The SAPs are consistent with MTCA guidance and the philosophy of a risk-based corrective action (RBCA) (American Society for Testing and Materials [ASTM], 1995). The RBCA philosophy uses a streamlined decision process designed to efficiently tailor an evaluation and corrective action measures to site-specific conditions. The RBCA philosophy integrates site assessment, remedial action selection, and monitoring with standard EPA risk and exposure modeling. When incorporated into an RI at the onset of the investigation, it ensures that site characterization activities are designed to collect the minimal amount of information necessary to make sound corrective action decisions, while also ensuring that human and ecological health are protected.

The RI work will be accomplished using a judgment-based sampling program design that will obtain data to evaluate potential contaminant pathways to receptors, complete the risk assessment, and support an evaluation of potential remedial action and no-further-action outcomes. The design relies in part upon the recently generated data from the ESI (EPA, 1998), and is intended to augment and confirm rather than reproduce all the information from that investigation. Specific details of the design, including location and frequency of sampling, are presented in the associated SAP (Volume II).

1.6 SCHEDULE

A preliminary project schedule is included as Table 1-1 and will be revised, as appropriate, as details of the program are developed. Details for sampling activities are contained in the SAP (Volume II).

Table 1-1. Preliminary Project Schedule

Task	Initiation (Days after Agreed Order Signed)	Estimated Duration (Days)
Field Mobilization	14	3
Soil Investigations:		
Coring	17	21
Sampling	17	14
Groundwater Investigations:		
Well Drilling Development	17	14
Tidal Influence Study	31	10
Slug Testing	41	10
Sampling	51	10
Sediment Investigations (Phase I):		
Vessel / Equip. Prep.	17	1
Sampling	18	28
Tissue Investigations:		
Vessel / Equip. Prep.	46	1
Sampling	47	14

2. PROJECT ORGANIZATION AND RESPONSIBILITIES

The project organization is shown on Figure 2-1. Key positions associated with project quality are described as follows.

2.1 PROJECT MANAGER

The Foster Wheeler Environmental Project Manager, Roy Hummell, is responsible for coordinating and scheduling all project activities, implementing the terms and conditions of this QAPP, and interfacing with Ecology, the SMT, and other agency personnel.

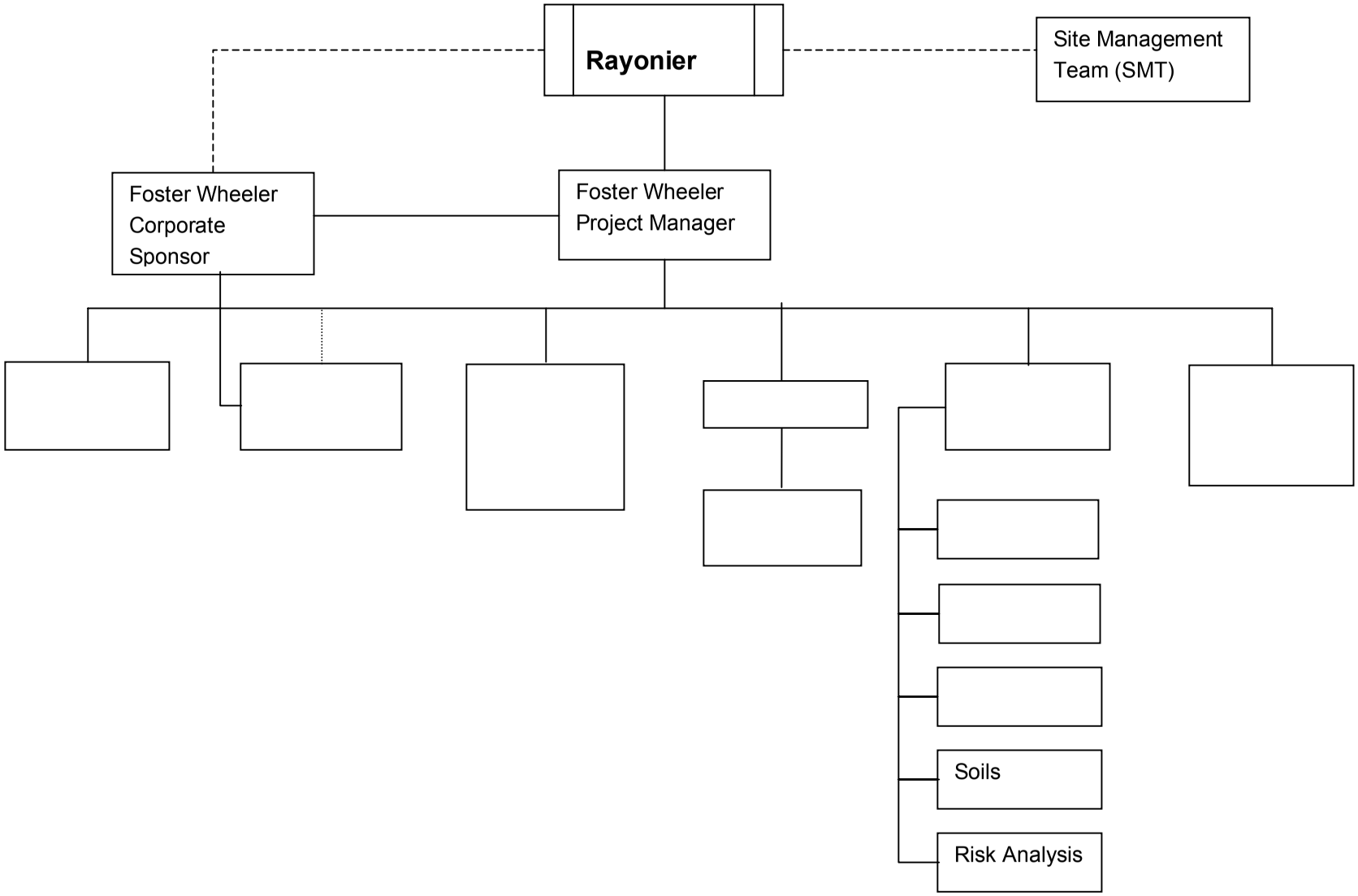
2.2 PROJECT QUALITY ASSURANCE MANAGER

The QA Manager, Roger Kadeg, is responsible for ensuring proper implementation of this QAPP and reports directly to the Foster Wheeler Environmental corporate sponsor who ensures overall project integrity. He is responsible for conducting formal QA audits and ensuring that all Foster Wheeler Environmental and subcontractor personnel have been properly trained and indoctrinated as applicable. The QA Manager or designated staff will review project policies, procedures, and guidelines and review the project activities to ensure the QA program is being properly implemented. This will include reviewing and signing-off on all project plans, conducting operational readiness meeting(s) prior to plan implementation, and inspecting project records to ensure conformance to all project plans and procedures.

2.3 PROJECT HEALTH AND SAFETY MANAGER

The Project Health and Safety Manager (PHSM), Steve Frost, is responsible for oversight and implementation of project health and safety-related activities as described in the Site Health and Safety Plan (SHSP) provided in Volume VII of the project submittals. The PHSM is assigned to the project by Foster Wheeler Environmental Corporate Health and Safety programs and, as such, has an independent line of reporting. He will review all activities to ensure they are in compliance with approved policies, procedures, laws, regulations, and guidelines pertaining to health and safety. He is also responsible for assigning Site Health and Safety Officers (SHSOs) as necessary to implement and comply with all requirements.

Figure 2-1. Project Organization Chart



The requirements are described in the SHSP, including daily health and safety site meetings before the start of work. Meetings will be documented in the field logbook.

2.4 QC MANAGER

The QC Manager, Sherri Wunderlich, is responsible for project-related quality aspects related to the collection and chemical analysis of all samples, as delegated by the Project Manager. Her primary role is to provide oversight to the data development and review process and oversight of all subcontracting laboratories. She is also responsible for reviewing and signing-off on the QAPP and SAP and for developing detailed scopes of work for the subcontracting laboratories that are incorporating the data quality objectives (DQOs) as described in Section 5. She will direct laboratory audits, as necessary, and data validation activities to ensure the DQOs as described in this QAPP (Table 3-1) are satisfied.

2.5 TECHNICAL LEADS

The project Technical Leads have the responsibility for project-related technical quality aspects delegated to them by the Project Manager. Technical Leads are discipline and project component oriented (e.g., upland sampling, aquatic sampling), and are assigned at the discretion of the Project Manager as the need arises.

2.6 FIELD OPERATIONS LEADS

The FOLs, to be assigned by the Project Manager, are responsible for the day-to-day activities in the field for their respective operations units. They will coordinate directly with the Technical Leads and the Project Manager, to implement all operations aspects of the project planning documents (QAPP, SHSP, and SAPs). They will maintain the site logbook, the official record of daily site activities. They will serve as the on-site management reporting to the project Technical Leads and the Project Manager. The FOLs will have a minimum of a Bachelor's degree in a relevant science discipline, and 3 years of progressive field experience. Depending on timing and schedule field tasks, the FOLs may be rotated. A verbal debriefing will be required to facilitate information transfer.

2.7 SUBCONTRACTORS

All subcontractors involved with the RI will be required to comply with the QA requirements of this QAPP. The QA Program implemented by a subcontractor will be reviewed and approved by the QA Manager prior to performance of work. A written report will be sent to file documenting this review.

3. DATA QUALITY OBJECTIVES

The QA objective for measurement data is to ensure that environmental monitoring data of known and acceptable quality are provided. Data from laboratory analysis of site samples will be used for site assessments. In particular, the data will be used to support the site conceptual model, which will be used to assess the risks to human health and the ecosystem. In addition, data will be used to screen the site in terms of the level and extent of contaminants. Table 3-1 indicates the analytical DQO level for each chemical analysis for each study. Method-specific DQOs for laboratory and field analyses are presented in Tables 3-1 through 3-5.

3.1 CHEMICAL TESTING

The QA objectives for analytical data are defined below:

1. **Precision:** Precision measures the reproducibility of measurements under a given set of conditions. Precision is expressed in terms of relative percent differences (RPDs). RPD is calculated as follows:

$$\text{RPD} = \frac{(\text{S- D})}{[(\text{S+ D})/2]} x\,100$$

Where: S = Initial Sample Result
D = Duplicate Sample Result

The laboratory objective for precision is to equal or exceed the precision demonstrated for similar samples, and RPD will fall within the established control limits for the sample preparation methods (Tables 3-2 to 3-5). In general, the matrix spike (initial sample result) and matrix duplicate (duplicate sample result) will be used to determine the precision, in accordance with typical laboratory Standard Operating Procedures (SOPs).

2. **Accuracy:** Accuracy is a measure of the bias or error in a measurement. Examples of bias include contamination and errors made in sample collection, preservation, handling, and analysis. Accuracy will be assessed by the collection of field/trip blanks and in the laboratory by the use of known and unknown QC samples and matrix spikes. Accuracy will be measured by the

percent recovery based on matrix spikes or surrogate recoveries. Percent recovery is calculated as follows:

$$\text{Percent Recovery} = \frac{(\text{SSR} - \text{SR})}{\text{SA}} x\,100$$

Where: SSR = spike sample result
SR = sample (unspiked) result
SA = spike added

The laboratory objective for accuracy is to equal or exceed the accuracy demonstrated for the analytical methods on similar samples, and will fall within the established control limits.

3. **Representativeness:** Representativeness is the degree to which the sample data accurately and precisely represent an environmental condition. Ensuring that sampling locations are selected properly and an adequate number of samples are collected, as developed in the SAPs, will satisfy representativeness. Field replicates will be used to assess representativeness; results should be within one-half order of magnitude (factor of 5) or less for a typical analysis.

4. **Completeness:** Completeness is the percent of measurements that are judged to be valid. The completeness of the data means that all the required samples have been taken and requisite analyses performed to generate an adequate database to successfully complete the remedial design studies. Completeness values will be 95 percent for demonstrated analytical techniques as described in Tables 3-1 to 3-5. Completeness will be determined by comparing the number of analyses attempted against the number of subsequent data points judged to be usable for the designated purpose(s).

5. **Comparability:** Comparability expresses the confidence with which one data set can be compared with another. The SAPs will specify that the sampling method employed, the chain-of-custody methods responsible for the transfer of the samples to the analytical laboratories, and the analytical techniques implemented at the laboratories be performed as specified in this QAPP, including the DQO levels shown in Tables 3-1 to 3-5.

Table 3-1. DQO Levels, Rayonier RI, Port Angeles

Location/ Area	Matrix Type	Samples: Est. No. Design[1/]	Est. No. Field QA/QC	Analytical Group	Sample Prep. Method	Analytical Protocol (EPA)	DQO Level
Port	Seds.			Conventionals:			
Angeles		59 (28)	3(2)	Total Solids	PSEP	PSEP	Definitive
Harbor –		59	3	TVS	PSEP	PSEP	Definitive
Mill Area		59	3	TOC	PSEP	PSEP	Definitive
		54	3	Total Sulfides	PSEP	PSEP	Definitive
		54	3	AVS	EPA (1991)	EPA (1991)	Definitive
		54	3	Ammonia	350.1	350.1	Definitive
		59	3	Grain Size	PSEP	PSEP	Definitive
				Organics:			
		33	2	SVOCs	PSEP	8270LL	Definitive
		21 (17)	2 (1)	PAHs	PSEP	8270LL	Definitive
		53 (28)	3 (2)	PCBs	PSEP	8270LL	Definitive
		(53)	(3)	PCB cong.	PSEP/8082	PSEP/8082	Definitive
		26 (17)	2 (1)	Phenols	PSEP	8270LL	Definitive
		41 (10)	3 (1)	Dioxins/Furans	Incld.	1613B	Definitive
		54 (33)	3 (2)	Resin Acids	3050B mod.	NCASI 85.02	Definitive
		56 (33)	3 (3)	Metals (excld. Hg)	PSEP	200.8	Definitive
		56 (33)	3 (3)	Mercury	PSEP	7471	Definitive
Port Angeles	Tissue			Organics:			
Harbor –	(aquatic)	27	2//	SVOCs	PSEP	8270C/SIM	Definitive
Mill		27	2/	PAHs	PSEP	8270C/SIM	Definitive
Area		27	2/	PCBs	PSEP	8082	Definitive
		(27)	2/	PCB cong	PSEP/8082	PSEP/8082	Definitive
		27	2/	Pesticides	PSEP	8081A	Definitive
		27	2/	Phenols	PSEP	8270C/SIM	Definitive
		27	2/	Dioxins/Furans	Incld.	1613B	Definitive
		27	2/	Metals	PSEP	200.8/7740	Definitive
		27	2/	Arsenic Speciation	PSEP	1632/1638 mod.	Definitive
		27	2/	Percent Lipids	PSEP/CLP	PSEP/CLP	Definitive
Dungeness Spit	Tissue			Organics:			
	(aquatic)	18	2/	SVOCs	PSEP	8270C/SIM	Definitive
		18	2/	PAHs	PSEP	8270C/SIM	Definitive
		18	2/	PCBs	PSEP	8082LL	Definitive
		18	2/	PCB cong	PSEP/8082	PSEP/8082	Definitive
		18	2/	Pesticides	PSEP	8081A	Definitive
		18	2/	Phenols	PSEP	8270LL	Definitive
		18	2/	Dioxins/Furans	Incld.	1613B	Definitive
		18	2/	Metals	PSEP	200.81/7740	Definitive

Table 3-1. DQO Levels, Rayonier RI, Port Angeles

Location/ Area	Matrix Type	Samples: Est. No. Design[1/]	Est. No. Field QA/QC	Analytical Group	Sample Prep. Method	Analytical Protocol (EPA)	DQO Level
		18	[2/]	Arsenic Speciation	PSEP	1632/1638 mod.	Definitive
		18	[2/]	Percent Lipids	PSEP/CLP	PSEP/CLP	Definitive
Fresh Water Bay	Tissue			Organics:			
	(aquatic)	15	[2/]	SVOCs	PSEP	8270C/SIM	Definitive
		15	[2/]	PAHs	PSEP	8270C/SIM	Definitive
		15	[2/]	PCBs	PSEP	8082LL	Definitive
		(15)	[2/]	PCB cong	PSEP/8082	PSEP/8082	Definitive
		15	[2/]	Pesticides	PSEP	8081A	Definitive
		15	[2/]	Phenols	PSEP	8270LL	Definitive
		15	[2/]	Dioxins/Furans	Incld.	1613B	Definitive
		15	[2/]	Metals	PSEP	200.8/774.0	Definitive
		15	[2/]	Arsenic Speciation	PSEP	1632/1638 mod.	Definitive
		15	[2/]	Percent Lipids	PSEP/CLP	PSEP/CLP	Definitive
QA/QC	Blanks,	NA	5	SVOCs	3510C/3520C	8270C/SIM	Definitive
	Rinsate	NA	3	PAHs	3510C/3520C	8270LL	Definitive
	and	NA	5	PCBs	3510C/3520C	8082	Definitive
	Trip	NA	5	Pesticides	3510C/3520C	8081A	Definitive
	Blanks	NA	5	Dioxins/Furans	Incld.	1613B	Definitive
	(water)	NA	3	Resin Acids	3520C mod.	NCASI 85.02	Definitive
		NA	5	Metals (excld. Hg)	3010A	6020	Definitive
		NA	5	Mercury	3020A	7471	Definitive
		NA	1	Arsenic Speciation	PSEP	1632/1638 mod.	Definitive

[1]Quantities in parenthesis represent additional optional samples, depending upon conditions encountered.

[2/] The nature of the sample collection is such that one of the tissue samples serves as a replicate.

Table 3-2. Reporting and QC Limits for Water

	CAS Number	Reporting Limits for Water[1/] (µg/L)	Project Specific QC Limits for Water[2/]	
			RPD	% R
Semi-Volatiles (GC/MS) (EPA Method 8270C)[3/]				
Acenaphthene	83-32-9	1.0	0-25	50-150
Acenaphthylene	208-96-8	1.0	0-25	50-150
Anthracene	120-12-7	1.0	0-25	50-150
Benzo(a)anthracene	56-55-3	1.0	0-25	50-150
Benzo(b)fluoranthene	205-99-2	1.0	0-25	50-150
Benzo(k)fluoranthene	207-08-9	1.0	0-25	50-150
Benzoic Acid	65-85-0	10.	0-25	50-150
Benzo(g,h,i)perylene	191-24-2	1.0	0-25	50-150
Benzo(a)pyrene	50-32-8	1.0	0-25	50-150
Benzyl Alcohol	100-51-6	5.0	0-25	50-150
Bis(2-chloroethoxy)methane	111-91-1	1.0	0-25	50-150
Bis(2-chloroethyl)ether	111-44-4	2.0	0-25	50-150
Bis(2-chloroisopropyl)ether	108-60-1	1.0	0-25	50-150
4-bromophenyl phenyl ether	101-53-3	1.0	0-25	50-150
Butyl benzyl phthalate	85-68-7	1.0	0-25	50-150
Carbazole	86-74-8	1.0	0-25	50-150
4-Chloroaniline	106-47-8	3.0	0-25	50-150
4-Chloro-3-methylphenol	59-50-7	2.0	0-25	50-150
2-Chloronaphthalene	91-58-7	1.0	0-25	50-150
2-Chlorophenol	95-57-8	1.0	0-25	50-150
4-Chlorophenyl phenyl ether	7005-72-3	1.0	0-25	50-150
Chrysene	218-01-9	1.0	0-25	50-150
Dibenzo(a,h)anthracene	53-70-3	1.0	0-25	50-150
Dibenzofuran	132-64-9	1.0	0-25	50-150
Di-n-butyl phthalate	84-74-2	1.0	0-25	50-150
1,2-Dichlorobenzene	95-50-1	1.0	0-25	50-150
1,3-Dichlorobenzene	541-73-1	1.0	0-25	50-150
1,4-Dichlorobenzene	106-46-7	1.0	0-25	50-150
3,3'-Dichlorobenzidine	91-94-1	5.0	0-25	50-150
2,4-Dichlorophenol	120-83-2	3.0	0-25	50-150
Diethyl phthalate	84-66-2	1.0	0-25	50-150
2,4-Dimethylphenol	105-67-9	3.0	0-25	50-150
Dimethyl phthalate	131-11-3	1.0	0-25	50-150
4,6-Dinitro-2-methylphenol	534-52-1	10.	0-25	50-150

Table 3-2. Reporting and QC Limits for Water

	CAS Number	Reporting Limits for Water[1/] (µg/L)	Project Specific QC Limits for Water[2/]	
			RPD	% R
2,4-Dinitrophenol	51-28-5	10.	0-25	50-150
2,4-Dinitrotoluene	121-14-2	5.0	0-25	50-150
2,6-Dinitrotoluene	606-20-2	5.0	0-25	50-150
Di-n-octyl phthalate	117-84-0	1.0	0-25	50-150
Bis(2-ethylhexyl)phthalate	117-81-7	1.0	0-25	50-150
Fluoranthene	206-44-0	1.0	0-25	50-150
Fluorene	86-73-7	1.0	0-25	50-150
Hexachlorobenzene	118-74-1	1.0	0-25	50-150
Hexachlorobutadiene	87-68-3	2.0	0-25	50-150
Hexachlorocyclopentadiene	77-47-4	5.0	0-25	50-150
Hexachloroethane	67-72-1	2.0	0-25	50-150
Indeno(1,2,3-cd)pyrene	193-39-5	1.0	0-25	50-150
Isophorone	78-59-1	1.0	0-25	50-150
2-Methylnaphthalene	91-57-6	1.0	0-25	50-150
2-Methylphenol	95-48-7	2.0	0-25	50-150
3-Methylphenol	108-39-4	1.0	0-25	50-150
4-Methylphenol	106-44-5	1.0	0-25	50-150
Naphthalene	91-20-3	1.0	0-25	50-150
2-Nitroaniline	88-74-4	5.0	0-25	50-150
3-Nitroaniline	99-09-2	6.0	0-25	50-150
4-Nitroaniline	100-01-6	5.0	0-25	50-150
Nitrobenzene	98-95-3	1.0	0-25	50-150
2-Nitrophenol	88-75-5	5.0	0-25	50-150
4-Nitrophenol	100-02-7	5.0	0-25	50-150
N-Nitrosodiphenylamine	86-30-6	1.0	0-25	50-150
N-Nitroso-di-n-propylamine	621-64-7	2.0	0-25	50-150
Pentachlorophenol	87-86-5	5.0	0-25	50-150
Phenanthrene	85-01-8	1.0	0-25	50-150
Phenol	108-95-2	2.0	0-25	50-150
Pyrene	129-00-0	1.0	0-25	50-150
1,2,4-Trichlorobenzene	120-82-1	1.0	0-25	50-150
2,4,5-Trichlorophenol	95-95-4	5.0	0-25	50-150
2,4,6-Trichlorophenol	88-06-2	5.0	0-25	50-150
Pesticides (GC) (EPA Method 8081A)[3,4/]				
Aldrin	309-00-2	0.05	0-25	50-150
Alpha-BHC	319-84-6	0.05	0-25	50-150
Alpha-Chlordane	5103-71-9	0.05	0-25	50-150
Beta-BHC	319-85-4	0.05	0-25	50-150

Table 3-2. Reporting and QC Limits for Water

	CAS Number	Reporting Limits for Water[1/] (µg/L)	Project Specific QC Limits for Water[2/]	
			RPD	% R
Delta-BHC	319-86-8	0.05	0-25	50-150
Gamma-BHC (Lindane)	58-89-9	0.05	0-25	50-150
Gamma-Chlordane	5103-74-2	0.05	0-25	50-150
4,4'-DDD	72-54-8	0.10	0-25	50-150
4,4'-DDE	72-55-9	0.10	0-25	50-150
4,4'-DDT	50-29-3	0.10	0-25	50-150
Dieldrin	60-57-1	0.10	0-25	50-150
Endosulfan I	959-98-8	0.05	0-25	50-150
Endosulfan II	33213-65-9	0.10	0-25	50-150
Endosulfan sulfate	1031-07-8	0.10	0-25	50-150
Endrin	72-20-8	0.10	0-25	50-150
Endrin Aldehyde	7421-36-3	0.10	0-25	50-150
Endrin Ketone	53494-70-5	0.10	0-25	50-150
Heptachlor	76-44-8	0.05	0-25	50-150
Heptachlor epoxide	1024-57-3	0.05	0-25	50-150
Methoxychlor	72-43-5	0.50	0-25	50-150
Toxaphene	8001-35-2	5.0	0-25	50-150
PCBs (GC/ECD) (EPA Method 8082)				
Aroclor 1016	12674-11-2	1.0	0-25	50-150
Aroclor 1221	11104-28-2	2.0	0-25	50-150
Aroclor 1232	11141-16-5	1.0	0-25	50-150
Aroclor 1242	53469-21-9	1.0	0-25	50-150
Aroclor 1248	12672-29-6	1.0	0-25	50-150
Aroclor 1254	11097-69-1	1.0	0-25	50-150
Aroclor 1260	11096-82-5	1.0	0-25	50-150
Metals (ICP/GFAA or ICP/MS) (EPA Methods 6010B/7000 or 6020)[5/]				
Arsenic	7440-38-2	NL (0.2 to 0.5)	0-20	75-125
Calcium	7440-70-2	NL (50)	0-20	75-125
Chromium	7440-47-3	NL (0.2 to 0.5)	0-20	75-125
Copper	7440-50-8	NL (0.1 to 0.5)	0-20	75-125
Lead	7439-92-1	NL (0.02 to 1)	0-20	75-125
Magnesium	7439-95-4	NL (20)	0-20	75-125
Nickel	7440-02-0	NL (0.2 to 0.5)	0-20	75-125
Potassium	7440-09-7	NL (20)	0-20	75-125

Table 3-2. Reporting and QC Limits for Water

	CAS Number	Reporting Limits for Water[1/] (µg/L)	Project Specific QC Limits for Water[2/]	
			RPD	% R
Selenium	7782-49-2	NL (1)	0-20	75-125
Sodium	7440-23-5	NL (100)	0-20	75-125
Zinc	7440-66-6	NL (0.5 to 4)	0-20	75-125
Polynuclear Aromatic Hydrocarbons (GC/MS -SIM) (EPA Method 8270C SIM)[6/]				
Acenaphthene	83-32-9	0.1	0-25	50-150
Acenaphthylene	208-96-8	0.1	0-25	50-150
Anthracene	120-12-7	0.1	0-25	50-150
Benzo(a)anthracene	56-55-3	0.1	0-25	50-150
Benzo(a)pyrene	50-32-8	0.1	0-25	50-150
Benzo(b)fluoranthene	205-99-2	0.1	0-25	50-150
Benzo(g,h,I)perylene	191-24-2	0.1	0-25	50-150
Benzo(k)fluoranthene	207-08-9	0.1	0-25	50-150
Chrysene	218-01-9	0.1	0-25	50-150
Dibenzo(a,h)anthracene	53-70-3	0.1	0-25	50-150
Fluoranthene	206-44-0	0.1	0-25	50-150
Fluorene	86-73-7	0.1	0-25	50-150
Indeno(1,2,3-cd)pyrene	193-39-5	0.1	0-25	50-150
Naphthalene	91-20-3	0.1	0-25	50-150
Phenanthrene	85-01-8	0.1	0-25	50-150
Pyrene	129-00-0	0.1	0-25	50-150

Sources: Volatiles, Semi-volatiles, Pesticides, PCBs, Metals, Polynuclear Aromatic Hydrocarbons (EPA, 1996a) (ARI, 2001); TPH (Ecology, 1997); Conventionals (EPA, 1983).

NA = Not applicable.

NL = A quantitation limit is not listed in the method.

[1/] Specific quantitation or reporting limits are matrix dependent. The limits listed herein are provided for guidance and may not always be achievable. For VOAs, RLs are based upon a 20 ml purge volume.

[2/] Project-specific QC limits are listed; the off-site laboratory will provide laboratory-specific guidelines developed from laboratory QC samples.

[3/] Because of the nature of the analytical method, other compounds may be identified than appear on this table.

[4/] Quantitation limits for individual target analytes are not listed in Method 8081A. The quantitation limits listed in this table are derived from recent laboratory detection limit studies (ARI, 2001) . Actual quantitation limits are a function of the specific instrument, matrix, and operating conditions, and must be determined by the laboratory.

[5/] For metals, the EPA methods list estimated instrument detection limits (IDLs) for guidance. Quantitation limits are not specified by the EPA methods, and are a function of the specific instrument, matrix, and operating conditions, and must be determined by the laboratory. Estimated quantitation limits, as provided in parentheses in this table, are typical of those that a laboratory can achieve by Method 6020.

[6/] EPA Method 8310 HPLC may be substituted if all criteria listed in this table are met.

Table 3-3. Data Quality Objectives for Sediment

Table 3-3. Data Quality Objectives for Sediment

	CAS Number	Recommended MDL or Estimated Quantitation Limit [1/]	SQS [2/]	Project Specific QC Limits for Sediment [3/]	
				RPD	% R
Conventionals					
Total Solids (%)	---	0.1	---	0-20	---
Total Volatile Solids (%)	---	0.1	---	0-20	---
Total Organic Carbon (%)	---	0.1	---	0-20	80-120
Total Sulfides (mg/kg)	---	1	---	0-20	80-120
Acid Volatile Sulfides (mg/kg)	---	NL (0.5)	---	0-20	80-120
Ammonia (mg/kg)	---	1	---	0-20	80-120
Grain Size	---	---	---	0-20	---
Metals (mg/kg dry weight)					
Antimony	7440-36-0	2.5	150	0-20	75-125
Arsenic, speciated (inorganic and organic)	---	NL (1)	---	0-20	75-125
Arsenic	7440-38-2	1.0	57	0-20	75-125
Cadmium	7440-43-9	0.3	5.1	0-20	75-125
Copper	7440-50-8	15.0	390	0-20	75-125
Lead	7439-92-1	0.5	450	0-20	75-125
Mercury	7439-97-6	0.02	0.41	0-20	75-125
Nickel	7440-02-0	2.5	140	0-20	75-125
Selenium	7782-49-2	1.0	---	0-20	75-125
Silver	7440-22-4	0.2	6.1	0-20	75-125
Zinc	7440-66-6	15.0	410	0-20	75-125
LPAH (μg/kg dry weight)					
Naphthalene	91-20-3	20	2,100	0-50	50-150
Acenaphthylene	208-96-8	20	560	0-50	50-150
Acenaphthene	83-32-9	20	500	0-50	50-150
Fluorene	86-73-7	20	540	0-50	50-150
Phenanthrene	85-01-8	20	1,500	0-50	50-150
Anthracene	120-12-7	20	960	0-50	50-150
2-Methylnaphthalene	91-57-6	20	670	0-50	50-150
Total LPAH	---	---	5,200	---	---
HPAH (μg/kg dry weight)					
Fluoranthene	206-44-0	20	1,700	0-50	50-150
Pyrene	129-00-0	20	2,600	0-50	50-150
Benzo(a)anthracene	56-55-3	20	1,300	0-50	50-150

Table 3-3. Data Quality Objectives for Sediment

	CAS Number	Recommended MDL or Estimated Quantitation Limit [1/]	SQS [2/]	Project Specific QC Limits for Sediment [3/]	
				RPD	% R
Chrysene	218-01-9	20	1,400	0-50	50-150
Benzofluoranthenes	---	20	3,200	0-50	50-150
Benzo(a)pyrene	50-32-8	20	1,600	0-50	50-150
Indeno(1,2,3-c,d)pyrene	193-39-5	20	600	0-50	50-150
Dibenzo(a,h)anthracene	53-70-3	20	230	0-50	50-150
Benzo(g,h,i)perylene	191-24-2	20	670	0-50	50-150
Total HPAH	---	---	12,000	---	---
Chlorinated Hydrocarbons (μg/kg dry weight)					
1,2-Dichlorobenzene	95-50-1	10	35	0-50	50-150
1,4-Dichlorobenzene	106-46-7	10	110	0-50	50-150
1,2,4-Trichlorobenzene	120-82-1	10	31	0-50	50-150
Hexachlorobenzene	118-74-1	10	22	0-50	50-150
Hexachlorobutadiene	87-68-3	10	11	0-50	50-150
Phthalates (μg/kg dry weight)					
Dimethylphthalate	99-65-0	10	71	0-50	50-150
Diethylphthalate	84-66-2	10	200	0-50	50-150
Di-n-butylphthalate	84-74-2	10	1400	0-50	50-150
Butylbenzylphthalate	85-68-7	10	63	0-50	50-150
bis(2-Ethylhexyl)phthalate	117-81-7	10	1300	0-50	50-150
Di-n-octylphthalate	117-84-0	10	6200	0-50	50-150
Other SVOCs (μg/kg dry weight)					
Dibenzofuran	132-64-9	10	540	0-50	50-150
N-nitrosodiphenylamine	86-30-6	10	28	0-50	50-150
Pyridine	110-86-1	200	---	0-50	50-150
Phenols (μg/kg dry weight)					
Phenol	108-95-2	20	420	0-50	50-150
2-Methylphenol	95-48-7	6	63	0-50	50-150
4-Methylphenol (co-elutes with 3-Methylphenol)	106-44-5	20	670	0-50	50-150
2,4-Dimethylphenol	105-67-9	6	29	0-50	50-150
Pentachlorophenol	87-86-5	61	360	0-50	50-150
PCBs (μg/kg dry weight)					
Aroclor 1242	53469-21-9	20	---	0-50	50-150
Aroclor 1254	11097-69-1	20	---	0-50	50-150

Table 3-3. Data Quality Objectives for Sediment

	CAS Number	Recommended MDL or Estimated Quantitation Limit [1/]	SQS [2/]	Project Specific QC Limits for Sediment [3/]	
				RPD	% R
Aroclor 1260	11096-82-5	20	---	0-50	50-150
Selected Congeners	---	NL (0.5)	---	0-50	50-150
Pesticides (μg/kg dry weight)					
Alpha-BHC	319-84-6	2	---	0-50	50-150
Beta-BHC	319-85-4	0.6	---	0-50	50-150
Delta-BHC	319-86-8	2	---	0-50	50-150
Gamma-BHC (Lindane)	58-89-9	0.4	---	0-50	50-150
4,4'- DDD	72-54-8	0.8	---	0-50	50-150
4,4'- DDE	72-55-9	0.8	---	0-50	50-150
4,4'- DDT	50-29-3	0.7	---	0-50	50-150
Resin Acids, Fatty Acids, and Bleach Plant Derivatives (mg/kg dry weight)					
3,4,5-Trichloroguaiacol	57057-83-7	NL (0.3)	---	0-50	50-150
Tetrachloroguaiacol	2539-17-5	NL (0.3)	---	0-50	50-150
Linoleic Acid	60-33-3	NL (0.3)	---	0-50	50-150
Oleic Acid/Linolenic Acid	---	NL (0.3)	---	0-50	50-150
Pimaric Acid	127-27-5	NL (0.3)	---	0-50	50-150
Isopimaric Acid	5835-26-7	NL (0.3)	---	0-50	50-150
Dehydroabietic Acid	1740-19-8	NL (0.3)	---	0-50	50-150
Abietic Acid	514-10-3	NL (0.3)	---	0-50	50-150
9,10-Dichlorostearic Acid	5829-48-1	NL (0.3)	---	0-50	50-150
14-Chlorodehydroabietic Acid	65281-76-7	NL (0.3)	---	0-50	50-150
12-Chlorodehydroabietic Acid	65310-45-4	NL (0.3)	---	0-50	50-150
Dichlorodehydroabietic Acid	57055-39-7	NL (0.3)	---	0-50	50-150
Dioxins/Furans (ug/kg dry weight)					
2,3,7,8-TCDD	1746-01-6	.001	---	0-50	50-150
Total TCDD	41903-57-5	---	---	---	---
2,3,7,8-TCDF	51207-31-9	.001	---	0-50	50-150
Total TCDF	55722-27-5	---	---	---	---
1,2,3,7,8-PeCDD	40321-76-4	.005	---	0-50	50-150
Total PeCDD	36088-22-9	---	---	---	---
1,2,3,7,8-PeCDF	57117-41-6	.005	---	0-50	50-150
2,3,4,7,8-PeCDF	57117-31-4	.005	---	0-50	50-150

Table 3-3. Data Quality Objectives for Sediment

	CAS Number	Recommended MDL or Estimated Quantitation Limit [1/]	SQS [2/]	Project Specific QC Limits for Sediment [3/]	
				RPD	% R
Total PeCDF	30402-15-4	---	---	---	---
1,2,3,4,7,8-HxCDD	39227-28-6	.005	---	0-50	50-150
1,2,3,6,7,8-HxCDD	57653-85-7	.005	---	0-50	50-150
1,2,3,7,8,9-HxCDD	19408-74-3	.005	---	0-50	50-150
Total HxCDD	34465-46-8	---	---	---	---
1,2,3,4,7,8-HxCDF	70648-26-9	.005	---	0-50	50-150
1,2,3,6,7,8-HxCDF	57117-44-9	.005	---	0-50	50-150
1,2,3,7,8,9-HxCDF	72918-21-9	.005	---	0-50	50-150
2,3,4,6,7,8-HxCDF	60851-34-5	.005	---	0-50	50-150
Total HxCDF	55684-94-1	---	---	---	---
1,2,3,4,6,7,8-HpCDD	35822-46-9	.005	---	0-50	50-150
Total HpCDD	37871-00-4	---	---	---	---
1,2,3,4,6,7,8-HpCDF	67562-39-4	.005	---	0-50	50-150
1,2,3,4,7,8,9-HpCDF	55673-89-7	.005	---	0-50	50-150
Total HpCDF	38998-75-3	---	---	---	---
OCDD	3268-87-9	.010	---	0-50	50-150
OCDF	39001-02-0	.010	---	0-50	50-150

Sources: Conventionals Metals except arsenic, LPAH, HPAH, Phenols, PCB Aroclors (PSEP, 1997); Arsenic, speciated (EPA, 1996b,c); PCB Congeners (EPA, 1996a); Resin Acids, Fatty Acids, and Bleach Plant Derivatives (NCASI); Dioxin/Furans (EPA, 1994a).

MDL = Method Detection Limit

NL = An MDL or estimated quantitation limit is not listed in the applicable method. The value listed in parentheses (if applicable) represents an estimated quantitation limit (uncorrected for sample moisture content) that may be achieved by a laboratory.

SQS = Sediment Quality Standard

--- = Not applicable.

[1/] Recommended MDLs are listed for target analytes that have SQLs and all conventionals. For the other target analytes, estimated quantitation limits are listed. Sample-specific quantitation limits are matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

[2/] The SQS values for nonionizable organic compounds listed herein are not TOC-based standards.

[3/] Project-specific QC limits are listed; the off-site laboratory may provide laboratory-specific guidelines developed from laboratory QC samples.

Table 3-4. Data Quality Objectives for Marine Biota

	CAS Number	Estimated Quantitation Limit [1/]	Project Specific QC Limits for Marine Biota [2/]	
			RPD	% R
Metals (mg/kg wet weight)				
Arsenic, speciated (inorganic and organic)	---	NL (0.002)	0-20	75-125
Arsenic	7440-38-2	NL (0.002)	0-20	75-125
Cadmium	7440-43-9	NL (0.04)	0-20	75-125
Copper	7440-50-8	NL (0.04)	0-20	75-125
Lead	7439-92-1	NL (0.2)	0-20	75-125
Mercury	7439-97-6	NL (0.05)	0-20	75-125
Selenium	7782-49-2	NL (0.4)	0-20	75-125
Zinc	7440-66-6	NL (0.15)	0-20	75-125
Polynuclear Aromatic Hydrocarbons (µg/kg wet weight)				
Acenaphthene	83-32-9	NL (0.5)	0-50	50-150
Acenaphthylene	208-96-8	NL (0.5)	0-50	50-150
Anthracene	120-12-7	NL (0.5)	0-50	50-150
Benzo(a)anthracene	56-55-3	NL (0.5)	0-50	50-150
Benzo(a)pyrene	50-32-8	NL (0.5)	0-50	50-150
Benzofluoranthenes	----	NL (0.5)	0-50	50-150
Benzo(b)fluoranthene	205-99-2	NL (0.5)	0-50	50-150
Benzo(k)fluoranthene	207-08-9	NL (0.5)	0-50	50-150
Benzo(g,h,i)perylene	191-24-2	NL (0.5)	0-50	50-150
Chrysene	218-01-9	NL (0.5)	0-50	50-150
Dibenz(a,h)anthracene	53-70-3	NL (0.5)	0-50	50-150
Fluoranthene	206-44-0	NL (0.5)	0-50	50-150
Fluorene	86-73-7	NL (0.5)	0-50	50-150
Indeno(1,2,3-c,d)pyrene	193-39-5	NL (0.5)	0-50	50-150
Naphthalene	91-20-3	NL (0.5)	0-50	50-150
2-Methylnaphthalene	91-57-6	NL (0.5)	0-50	50-150
Phenanthrene	85-01-8	NL (0.5)	0-50	50-150
Pyrene	129-00-0	NL (0.5)	0-50	50-150
Total LPAH	---	---	---	---
Total HPAH	---	---	---	---
Phenols (µg/kg wet weight)				
Pentachlorophenol	87-86-5	NL (25)	0-50	50-150

Table 3-4. Data Quality Objectives for Marine Biota

	CAS Number	Estimated Quantitation Limit [1/]	Project Specific QC Limits for Marine Biota [2/]	
			RPD	% R
SVOCs (µg/kg wet weight)				
Pyridine	110-86-1	NL (<70)	0-50	50-150
Pesticides (µg/kg wet weight)				
Alpha-BHC	319-84-6	NL (0.5 to 2)	0-50	50-150
Beta-BHC	319-85-7	NL (0.5 to 2)	0-50	50-150
Delta-BHC	319-86-8	NL (0.5 to 2)	0-50	50-150
Gamma-BHC (Lindane)	58-89-9	NL (0.5 to 2)	0-50	50-150
4,4'- DDD	72-54-8	NL (0.7)	0-50	50-150
4,4'- DDE	72-55-9	NL (0.7	0-50	50-150
4,4'- DDT	50-29-3	NL (0.7)	0-50	50-150
PCBs (µg/kg wet weight)				
Aroclor 1242	53469-21-9	NL (1.5 to 3)	0-50	50-150
Aroclor 1254	11097-69-1	NL (1.5 to 3)	0-50	50-150
Aroclor 1260	11096-82-5	NL (1.5 to 3)	0-50	50-150
Selected Congeners	---	NL (0.5)	0-50	50-150
Dioxins/Furans (µg/kg wet weight)				
2,3,7,8-TCDD	1746-01-6	.00012	0-50	50-150
Total TCDD	41903-57-5	---	0-50	50-150
2,3,7,8-TCDF	51207-31-9	.00013	0-50	50-150
Total TCDF	55722-27-5	---	0-50	50-150
1,2,3,7,8-PeCDD	40321-76-4	.00025	0-50	50-150
Total PeCDD	36088-22-9	---	0-50	50-150
1,2,3,7,8-PeCDF	57117-41-6	.00014	0-50	50-150
2,3,4,7,8-PeCDF	57117-31-4	.00018	0-50	50-150
Total PeCDF	30402-15-4	---	0-50	50-150
1,2,3,4,7,8-HxCDD	39227-28-6	.00038	0-50	50-150
1,2,3,6,7,8-HxCDD	57653-85-7	.00048	0-50	50-150
1,2,3,7,8,9-HxCDD	19408-74-3	.0003	0-50	50-150
Total HxCDD	34465-46-8	---	---	---
1,2,3,4,7,8-HxCDF	70648-26-9	.00027	0-50	50-150
1,2,3,6,7,8-HxCDF	57117-44-9	.00023	0-50	50-150
1,2,3,7,8,9-HxCDF	72918-21-9	.00014	0-50	50-150
2,3,4,6,7,8-HxCDF	60851-34-5	.00025	0-50	50-150

Table 3-4. Data Quality Objectives for Marine Biota

	CAS Number	Estimated Quantitation Limit [1/]	Project Specific QC Limits for Marine Biota [2/]	
			RPD	% R
Total HxCDF	55684-94-1	---	---	---
1,2,3,4,6,7,8-HpCDD	35822-46-9	.00041	0-50	50-150
Total HpCDD	37871-00-4	---	---	---
1,2,3,4,6,7,8-HpCDF	67562-39-4	.00052	0-50	50-150
1,2,3,4,7,8,9-HpCDF	55673-89-7	.00042	0-50	50-150
Total HpCDF	38998-75-3	---	---	---
OCDD	3268-87-9	.00035	0-50	50-150
OCDF	39001-02-0	.0014	0-50	50-150
Other				
Percent Lipid	---	---	0-50	---

Sources: Arsenic, speciated (EPA, 1996b,c); Pesticides; PAHs, Phenols, PCB Aroclors (PSEP, 1997); PCB Congeners and Percent Lipids (EPA, 1996a); Dioxin/Furans (EPA, 1994a).

NL = An estimated quantitation limit is not listed in the applicable method. The value listed in parentheses (if applicable) represents an estimated quantitation limit that may be achieved by a laboratory.

--- = Not applicable.

[1/] Sample-specific quantitation limits are matrix dependent. The estimated quantitation limits listed herein are provided for guidance and may not always be achievable. Limts for PAHs based on SIM technique reporting to MDLs. Limits for PCBs may require method modifications and are based on reporting to MDLs. Limits for dioxins/furans are based upon a recent laboratory MDL study using a 20 gram sample in fish tissue; limits for other species may be higher. Limits will vary between laboratories and individual analytical runs.

[2/] Project-specific QC limits are listed; the off-site laboratory may provide laboratory-specific guidelines developed from laboratory QC samples.

Field measurement QA objectives will be addressed as follows:

All field instruments will be calibrated in accordance with the manufacturer's instruction and/or the associated SOPs to address accuracy. Precision will be addressed by taking replicate measurements, and comparing these measurements to the manufacturer's specifications for the individual instrument. Representativeness will be based on professional judgment by examining the matrix from which the sample was measured and/or collected. The completeness goal is 95 percent, based on the proposed number of measurements compared to the number of completed measurements. Samples will be considered comparable if the instrument is functioning within the manufacturer's specifications and if calibrations are made within the recommended frequency as specified by the manufacturer or the associated SOP.

The sample design for the project, including the number of samples, duplicates, and blanks for each material to be sampled for each study, are presented in the SAP (Volume II).

3.2 BIOLOGICAL TESTING

The bioassay procedures for this project are described in detail in Volume II: Sampling and Analysis Plan—Marine Environment. The amphipod bioassay and bivalve larvae bioassay tests will be conducted to evaluate acute toxicity. The 20-day juvenile polychaete bioassay will be performed to evaluate chronic toxicity. These toxicity tests will incorporate standard QA/QC procedures to ensure that the test results are valid. Standard QA/QC procedures include the use of a negative control, a positive control, reference sediment samples, and measurement of water quality during testing. Table 3-5 summarizes test conditions and performance standards for the marine bioassays that will be used for the sediment toxicity tests.

Table 3-5. Performance Standards for Sediment Management Standard Marine Bioassays

Toxicity Test *Test Species*	Frequency of Water Quality Monitoring		Control Limits			Control Samples			Performance Standards[1/]
	Temperature, Salinity, Dissolved Oxygen, pH	Sulfides, Ammonia	Temp (°C)[5/]	Salinity (ppt)	Dissolved Oxygen (% saturation)	Negative Control	Positive Control	Reference Sediment	
Acute Effects Tests									
Amphipod *Rhepoxynius abronius*	Daily	Beginning/ end (optional)	15±1	28±1	NA[2/]	Clean sediment	Reference toxicant in seawater	Yes	Mean mortality in control sediment <10 percent and mean mortality in reference sediment <25 percent.
Amphipod *Ampelisca abdita*	Daily	Beginning/ end (optional)	20±1	28±1	NA[2/]	Clean sediment	Reference toxicant in seawater	Yes	Mean mortality in control sediment <10 percent and mean mortality in reference sediment <25 percent.
Amphipod *Eohaustorius estuarius*	Daily	Beginning/ end (optional)	15±1	Ambient (same as interstitial)	NA[2/]	Clean sediment	Reference toxicant in seawater	Yes	Mean mortality in control sediment <10 percent and mean mortality in reference sediment <25 percent.
Larval Oyster (*Crassostrea gigas*)	Daily	Beginning/ end	20±1	28±1	>60[3/]	Clean seawater	Reference toxicant in seawater	Yes	Mean combined mortality and abnormality in control seawater <30 percent.
Larval Mussel (*Mytilus* sp.)[4/]	Daily	Beginning/ end	16±1	28±1	>60[3/]	Clean seawater	Reference toxicant in seawater	Yes	Mean combined mortality and abnormality in control seawater <30 percent.
Larval Sand dollar (*Dendraster excentricus*)	Daily	Beginning/ end	15±1	28±1	>60[3/]	Clean seawater	Reference toxicant in seawater	Yes	Mean combined mortality and abnormality in control seawater <30 percent.
Larval Sea urchin (*Strongylocentrotus purpuratus* or *S. droebachiensis*)	Daily	Beginning/ end	15±1	28±1	>60[3/]	Clean seawater	Reference toxicant in seawater	Yes	Mean combined mortality and abnormality in control seawater <30 percent.
Chronic Effects Tests									
Neanthes arenacoedentata 20 day	3 times/week (M,W,F)	Beginning/ end	20±1	28±2	NA[2/]	Clean sediment	Reference toxicant in seawater	Yes	Mean initial worm weight target 0.5 mg dw/ind (minimum 0.25 mg dw/ind). Mean mortality in control sediment <10 percent and mean individual growth $\geq$ 0.72 mg ind/day (minimum 0.38 mg dw/ind/day). Mean individual growth rate in reference sediment $\geq$ 80 percent of mean indiviual growth rate in control sediment (Ecology 1995 Littleton and Kendall 1995, Kendall 1996)

Note: NA - not applicable
ppt - parts per thousand

1/ Performance standards in WAC 173-204-315(2) for acute effects tests and EPA and COE (2001) for the chronic 28-day amphipod test..

2/ Continuous aeration is required by the protocol, so the dissolved oxygen concentration should be >90 percent saturation (ASTM 1996 - Method 1367 and Method 1611).

3/ Aeration should be initiated if the dissolved oxygen concentration declines below 60 percent of saturation or if high sulfides and ammonia are present, aeration should be initiated and continued in all test containers throughout the test so that dissolved oxygen remains at 60 - 100 percent saturation.

[4/] PSEP (1995) and the SMS refer only to the use of *Mytilus edulis* in this test. However, it may be more accurate to refer to the test organisms used as members of the *Mytilus edulis* sibling species complex. Recent taxonomic studies of west coast mussels indicate that the mussels in Washington state are either *M. trossulus* (a more northerly species) or *M. galloprovincialis* (a more southerly species). The mussel species being used by most biological laboratories in the northwest is *M. galloprovincialis*. *M. edulis* does not occur locally and is therefore unlikely to be used in toxicity tests. This does not constitute a change in test organisms, but an acknowledgment that the organisms may have been previously misidentified

[5/] Temperature tolerances are expressed as a time-weighted average for the duration of the test. Individual temperature measurements may vary by up to $\pm$ 3°C (ASTM 1996 – Methods E1367, E724, E1563).

4. SAMPLING PROCEDURES

The specific methods and techniques to be used while performing sampling in accordance with the quality control protocols to meet the requirements of this QAPP are contained in the SOPs, which are included in Appendix A of the SAP (Volumes II). The SAP and SOPs establish the method of sampling to comply with the following requirements.

4.1 SAMPLING PROCEDURES AND PROTOCOLS

The SAP and/or SOPs will include sampling locations, design, and sampling techniques; decontamination procedures; sampling equipment; and calibration procedures. Specific QC and documentation protocols applicable to sampling procedures are discussed in the SOPs and generally will be based on acceptable EPA and Ecology practices. Conventional sampling practices will be followed. A summary of the sample design, analytical DQOs, and analytical site performance parameters is presented in Tables 3-1 through 3-5.

4.2 SAMPLE VOLUME

The volume of samples will be established in the SAP (Volume II) and will follow general EPA guidance and method requirements.

4.3 SAMPLE PRESERVATION

It is important to maintain the integrity of the samples from the time they are collected until the analyses are completed. The samples, therefore, will be preserved at the time of collection, and before transportation and storage to prevent or retard degradation or modification of chemicals in the samples. Sample preservation requirements are described in the SAPs.

4.4 SAMPLE CUSTODY

The history of each sample and how the sample is handled is documented from the time the sample is collected through all transfers of custody until it is received at the analytical laboratory. Internal laboratory records then document the custody of the sample through final disposition. Procedures for sample custody are described below and in the SAP (Volume II).

A sample is considered to be in someone's custody if:

- It is in one's actual physical possession;
- It is in one's view, after being in one's physical possession;
- It is in one's physical possession and then locked or otherwise sealed so that tampering would be evident; or
- It is kept in a secure area, restricted to authorized personnel only.

4.4.1 Sample

A sample is physical evidence collected from the environment. An essential part of sample custody is the control of this evidence gathered from the environment. To accomplish this, sample identification and chain-of-custody procedures will be followed as described in this section.

4.4.2 Sample Identification and Log

The type of measurement or analysis performed on the sample determines how a sample will be identified. On-site measurements will be recorded on field data forms specified in the SAP (Volume II) including identification information, such as project code, station numbers, station location, date, time, samplers, field observations, and remarks. The authors will sign and date the completed forms using black ink and the Project Manager will maintain the forms as project records.

All collected samples will be uniquely identified by the sample label described in the SAP (Volume II). All sample labels will be filled out using dark, waterproof ink. Each sample will be designated by a unique alphanumeric code that will identify the specific sample. These samples will be placed in coolers and transported from the site location to the contract laboratory. When sent by common carrier, samples, as required, will be packaged and labeled according to procedures specified by the U.S. Department of Transportation (DOT) (Code of Federal Regulations [CFR], Section 49) in appropriate containers to maintain sample integrity. Before removal from the sample location, a sample may be separated into portions depending upon the analyses to be performed. Each portion will be preserved as necessary. The information recorded on the sample label will include the following, as appropriate:

- Project Name
- Work Charge Number
- Field Sample Number
- Sample Location
- Date
- Time
- Type of Analysis
- Preservation Notes
- Sampling Technician (initials)
- Media
- Sample Type
- Remarks (optional)
- Laboratory Number

The sample label will contain an appropriate place for designating the sample as a grab or a composite and identifying the type of sample collected for analyses. The sample label will be attached to each sample or container. After collection, separation, identification, and preservation, the sample will be maintained under chain-of-custody procedures through delivery to and analysis by the contract laboratory.

The FOLs will maintain a daily site logbook, including a summary of daily activities, observations, milestones, surveillances, checks, and other information as necessary. The logbook will be bound and weatherproof with sequentially numbered pages. The author will sign and date logbook entries, and each entry will be legibly written in dark, waterproof ink. The notations will include accurate and inclusive documentation of the individuals' daily activities, including personnel on site, weather, arrival and departure of visitors and equipment, sample pickup, logsheet numbers, start and completion of activities, health and safety issues, etc. The logbook will contain only facts and observations. Language will be objective and factual. The site logbook will be initiated at the start of the first on-site activity; entries will be made for every day that on-site activities occur. The site logbook will become part of the permanent site record and may be admitted as evidence in court. It is critical that this document be properly maintained.

If an error is made when recording information, the error may be corrected by lining through the error (so as not to obscure the original entry), entering the correct information, and initialing and dating the entry in dark, waterproof ink.

4.4.3 Chain-of-Custody

The samples collected during the site investigations must be traceable from the time the samples are collected until they or their derived data are used in the final report. In order to maintain and document sample possession, the following chain-of-custody procedures will be implemented.

4.4.3.1 Field Custody Procedures

(a) Containers will be batched in lots along with documentation to indicate their integrity. Boxes will be sealed with custody tape for shipment to the site for use. Their integrity will be determined by the FOL prior to use. Containers found to be damaged or boxes with broken seals will not be used.

(b) Samples will be collected as described in the SAPs and attached SOPs (Volume II).

(c) The FOLs are responsible for the care and custody of the samples collected until they are properly transferred or dispatched to the laboratory.

(d) When photographs are taken as part of the documentation procedure, the name of the photographer, date, time, site location, and site description will be entered sequentially in the logbook as photographs are taken. Polaroid and developed photographic prints will be serially numbered and dated and correspond to the logbook descriptions.

(e) Sample labels will be written for each sample, using dark, waterproof ink unless prohibited by weather conditions (e.g., a logbook notation would explain that a pencil was used to fill out the sample label because a ballpoint pen would not function in freezing weather).

(f) The FOLs, under the direction of the QC Manager, will determine whether proper custody procedures were followed during the field work and will decide if additional samples are required as a result of questionable custody procedures or documentation.

(g) If a sample is lost or destroyed during shipment, a written statement will be prepared by the FOL and given to the Project Manager and QC Manager detailing how the sample was collected and shipped to the laboratory. The statement will include all pertinent information, such as entries in the field logbooks regarding the sample, whether the sample was in the sample collector's physical possession or in a locked compartment until shipped to the laboratory, the shipper and associated shipping records, existing custody terms, and ultimate fate (if known) of the sample (EPA, 1978).

4.4.3.2 Transfer of Custody and Shipment

(a) All laboratory samples will be accompanied by a chain-of-custody record. An example of the chain-of-custody form to be used is included in the SAPs. The

custody record will be written using dark, waterproof ink. Any corrections will be made by drawing a line through, initialing and dating the change, then entering the correct information. Erasures or white-outs will not be permitted. When transferring the possession of samples, the individuals relinquishing and receiving the samples will sign, date, and note the time on the chain-of-custody record. This record documents sample custody transfer from the sampler, often through another person or common carrier, to the analyst in the laboratory and throughout the laboratory procedures.

(b) Samples will be packaged according to DOT and sample preservation requirements for shipment and dispatched to the laboratory for analysis, with a duplicate custody record copy accompanying each shipment (e.g., one for the field, one for samples shipped to the off-site laboratory). All samples will be placed in coolers along with appropriate chain-of-custody forms. Each individual container will be sealed with custody tape (unless the container, e.g., GRO, is tarred and/or is not appropriate for sealing). Samples and forms will be enclosed in waterproof plastic bags that are sealed. Empty space within the cooler shall be filled with bubble wrap, styrofoam beads, vermiculite, or other materials to prevent shifting or breakage during shipment. Shipping containers will be sealed for shipment to the laboratory and a custody seal will be placed over the top and side of the lid at the most likely point of rupture to ensure the package has not been tampered with. The sampler or designated sample packager will initial and date this seal. The method of shipment, courier name(s), and other pertinent information will be entered in the "Remarks" section on the custody record.

(c) If any samples are split or are for inter-laboratory comparison, a separate Receipt for Samples form will be prepared for those samples and marked to indicate for whom the samples are being split. The person relinquishing the samples to the facility or agency will obtain the required signature of a representative of the appropriate party to acknowledge receipt of the samples. If a representative is unavailable or refuses to sign, this will be noted in the "Received by" space. When appropriate, as in the case where the representative is unavailable, the custody record will contain a statement that the samples were delivered to the designated location at the designated time. This disposition does not jeopardize the chain-of-custody for the split sample portion retained for analysis by Foster Wheeler Environmental.

(d) All shipments will be accompanied by the chain-of-custody record to identify contents. The original record will accompany the shipment, and the copy will be retained by the FOLs for inclusion in project records.

(e) All samples to be shipped to a laboratory will be shipped by express mail service for overnight delivery. The package will be registered with return receipt requested. If sent by common carrier or airfreight, proper documentation will be maintained.

4.4.3.3 Laboratory Custody Procedures

(a) A sample custodian or designated alternate accepts custody of the shipped samples and verifies that the information on the sample labels matches the information on the chain-of-custody records. Pertinent information such as shipment, pickup, courier, etc. will be entered in the "Remarks" section. The custodian then enters the sample label data into the sample tracking system of the laboratory. This system will use the sample label number or assign a unique laboratory number to each sample label and will ensure that all samples are transferred to the proper analyst and are stored in the appropriate secure area according to method specifications.

(b) Samples are distributed to the appropriate analysts as described in the laboratory procedures. Laboratory personnel are responsible for the care and custody of samples from the time they are received until the sample is exhausted or dispersed. All samples and extracts will be held for a minimum of 30 days or until the end of project, whichever is greater. Archived samples must be kept in a preserved state until released by the Foster Wheeler Environmental Project Manager or designee (typically QC Manager).

(c) When sample analyses and necessary QA checks have been completed in the laboratory, the unused portion of the sample and the sample container must be properly disposed of in accordance with all federal and state laws, rules, and regulations. Sample and extract disposal will be the responsibility of the laboratory. All identifying tags, data sheets, chain-of-custody, and laboratory records will be retained as part of the permanent documentation. Samples received by the laboratory will be retained until analyses and QA checks are completed.

This page left intentionally blank.

5. ANALYTICAL PROCEDURES

5.1 BACKGROUND

The analytical methods, both qualitative and quantitative, implemented in the field and at the laboratory will comply with EPA and Ecology-approved guidelines (Table 3-1) and will be incorporated into the SAPs (by reference). The analytical laboratory will be selected from a list of pre-qualified laboratories developed by the QC Manager. Criteria for qualification will consider capabilities (including equipment and personnel); certifications; associated performance on evaluation samples, audits and Method Detection Limit (MDL) studies on similar matrices; experience; references; and pricing. Field measurements will be conducted by Foster Wheeler Environmental or its subcontractors, under the supervision of Foster Wheeler Environmental personnel (FOL or designee).

5.2 SPECIFIC ANALYTICAL CHEMICAL PROCEDURES

Standard EPA, Puget Sound Estuary Program (PSEP), and Ecology methods will be referenced as appropriate in Tables 3-1 to 3-5 and in the SAP. Other methods will be submitted in a format that will describe in detail the exact procedures and materials required to analyze the samples. The following items shall be included, at a minimum, in the procedure:

- Medium of application (i.e., water, soil, air)
- Principle of method
- Sample size requirements
- Detection limits and/or Practical Quantitation Limits (PQL)
- Interferences and corrective measures
- Apparatus (including instrumental parameters)
- Reagents
- Calibration procedure
- Sample preparation (i.e., extraction, digestion)
- Diagrams or tables that describe the method

- Step-by-step analytical procedure
- Details of calculation
- QC requirements (i.e., blanks, spikes, duplicates)
- Report requirements
- References

Data will be included, if appropriate, to support the limitations and the applicability of the method.

If at any time a change in the documented laboratory SOP is required, the QC Manager will examine and evaluate the significance of the change. If the change/modification is determined to be significant, the QC Manager will require additional precision, accuracy, and detection limit data either to demonstrate that the previous estimates of the limitations remain valid, or to develop the necessary data for accuracy describing the new methods. EPA or state agency guidelines, as appropriate, will be followed for acceptance of alternative methods. Any substantive changes to the QAPP (requiring a revision) must be approved by the signatories of the QAPP.

The QC Manager may use these SOPs as the basis for performing audits of laboratory practices and reviewing laboratory results.

Field measurements will be taken following procedures as described in the SAP Appendices (Volume II).

5.3 TEST METHODS

The methods for conducting the tests of samples will follow either standard EPA, ASTM, Water Environment Federation (WEF), PSEP, National Council of the Paper Industry for Air and Stream Improvement (NCASI), or Ecology procedures. Field measurements will be taken following the above methods, where applicable, as implemented by the SOPs.

5.4 CONTROL OF TESTING

The laboratory program for controlling the testing of project samples is described in the approved Laboratory QA Plan. Field measurements will follow the SOPs in the SAP Appendices (Volume II).

5.5 LIMITS OF DETECTION

The basis for limits of detection for the analytical laboratory will be described in the Laboratory QA Plan or associated laboratory SOPs, and calculated as required by 40 CFR Part 136, Appendix B. Thus, actual MDLs are laboratory-specific and a function of the equipment operating conditions and sample matrices. Typical MDLs or PQLs, as published by EPA and specified as estimated quantitation limits, are presented in Tables 3-2 through 3-5. These will be considered as the objectives for this project, recognizing that they may not always be achievable for a given operating or sample condition. Field detection limits will follow the manufacturer's specifications for the individual instruments.

5.6 EQUIPMENT CONTROL AND CALIBRATION

This section describes the requirements for control, calibration, adjustment, and maintenance of field and analytical measuring and testing devices used for performing tests. Devices will be calibrated and adjusted at specified, predetermined intervals using equipment and material (i.e., calibration gases) having known valid relationships to National Institute of Standards and Testing (NIST) or other certified standards.

Calibration activities will be performed as described in SOP 4, Field Instrument Calibration in Volume II.

5.6.1 Responsibility and Controls

The FOLs are responsible for ensuring implementation of the following procedures for field-calibrated equipment:

(a) A procedure is established to include the measuring and testing devices to be calibrated and the frequency of calibration of these devices. This procedure will be appended to the SAP as individual instrument SOPs. The method and interval of calibration will be based on the type of device, stability characteristics, required accuracy, and other conditions affecting measurement control. Calibration information also will be maintained in the site logbooks.

(b) The measuring and testing devices used are of the proper range, type, and accuracy for the test being performed.

(c) An instrument logbook is maintained for each measuring and testing device, including, at a minimum, the following information:

- Name of device
- Device serial and/or identification number
- Frequency of calibration
- Date of last calibration
- Name of party performing last calibration
- Due date for next calibration

(d) Measuring and testing devices are marked with calibration due dates when possible. When this marking is not possible, alternative methods of tracing the device to its calibration date (such as serialization) will be employed.

(e) Measuring and testing devices are calibrated in accordance with the requirements of this section. Before use in the field, each instrument is calibrated and documentation is made in the instrument logbook.

(f) A system for issuance, collection, and return of all measuring and testing devices is developed, maintained, and presented in the SAPs. This system will include a means to identify the personnel withdrawing devices, methods for issuing devices, and methods for collecting and/or returning of devices at prescribed times or as otherwise required.

(g) Methods are employed to ensure proper handling, storage, and care of the test equipment in order to maintain its required accuracy. To this end, SOPs for each kind/type of field test equipment will be appended to the SAPs. Typically, these will consist of the manufacturer's recommended SOPs, including specifications for accuracy, precision, etc. In addition, these specifications will be added to the DQO tables, if available.

5.6.2 Calibration Frequency for Field Equipment

Field equipment used for on-site measurements will be calibrated before and after daily use. A list of equipment to be used during the field sampling program, including the respective calibration technique, will be included in the Calibration SOP in the SAPs. If any measuring or test device requiring calibration cannot immediately be removed from service, the FOLs can extend the calibration cycle is a review of the equipment's history warrants

the issuance of an extension. No equipment will be extended more than twice a calibration cycle, nor will the extension exceed one-half the prescribed calibration cycle.

5.6.3 Laboratory Calibration and Control Practices

The calibration procedures and frequency followed by the laboratory will be conducted in accordance with standard EPA or Ecology protocols and the Laboratory QA Plan. These plans will be provided to the Foster Wheeler Environmental QC Manager upon request. The laboratory QA Plan will be approved or certified by Ecology. Calibration and QA procedures will indicate instrument stability and sensitivity, and will verify and document instrument conditions before and during testing.

5.6.4 Equipment Repair and Actions

(a) Field and laboratory test equipment that does not meet specified QA requirements will be recalibrated in accordance with method specifications and manufacturer requirements in accordance with the SOPs. When field test equipment is found to be out of calibration, damaged, lost or stolen, an evaluation will be made to ascertain the validity of previous measurements and the acceptability of these results since the last calibration check. If measurements are suspected to be inaccurate or invalid, the original measurements and testing will be repeated using properly calibrated equipment, or the associated previous data will be flagged as suspect. Suspect measurements will be listed in a nonconformance report or a deficiency notice, as applicable.

(b) Test equipment consistently found to be out of calibration will be repaired or replaced.

(c) Inspection and test reports will include identification of the test equipment used to perform the inspection and/or tests. A corrective action report will be completed for any instrument found to be defective, inoperable, or faulty. This report will include the identification of the instrument, date and time of the test, a description of the test or evaluation, corrective action taken, and name and initials of responsible party. This information will be noted in the instrument logbook.

This page left intentionally blank.

6. DATA REDUCTION, VERIFICATION, AND REPORTING

This section describes the process for generating and checking data, as well as the process for producing reports for field and analytical laboratory data.

6.1 DATA REDUCTION

6.1.1 Definition

Data reduction is the process of converting raw data to final results. Project-specific data reduction methods are designed to ensure that data are accurately and systematically reduced into a usable form. The data generated for this investigation will be used to support tiered risk screening in a qualitative and, where appropriate, quantitative manner using a judgment-based approach. Therefore, data reduction for the RI may include computation of summary statistics (e.g., means, geometric means, and medians) and their standard errors (standard deviations), calculation of confidence intervals, testing of hypotheses relative to the parameters, and model validation. Statistically acceptable procedures for the above will be implemented as defined in any one of several standard texts (e.g., Zar, 1974; Freund, 1973).

6.1.2 Data Usage

The data generated at site and/or in the laboratory will be used to support the professional judgment-based decisions and the risk evaluations. The laboratories will provide their standard report package format. These data will be detailed in tabular form (e.g., a summary spreadsheet format), identifying all "hits" (detections greater than detection limit) by specific site areas as defined in the SAP (Volumes II) so the information can be entered into the appropriate risk models, or plotted to illustrate level and extent of contamination.

6.1.3 Supplementary Data

Supplementary data produced for internal records and not reported as part of the analytical data may include laboratory worksheets, laboratory notebooks, sample tracking system forms, instrument logs, standards records, maintenance records, calibration records, and associated quality control records. These data will be available for inspection during audits and when needed to determine the validity of data.

Data from other sources will not be used in project analysis or reports until the QC Manager can be assured that the data were collected and analyzed according to procedures and protocols specified in this QAPP and associated SAPs. The source of outside data will be included in project reports where these data are used.

6.1.4 Review of Data Reduction

In order to verify the accuracy of data reduction, the following procedures will be implemented:

- Technical staff will document and review their own work and will be accountable for the accuracy of that work.
- Major calculations will be subject to an independent technical review by a Technical Lead or other suitably experienced party (internal to Foster Wheeler Environmental) to ensure that both the methods and the calculations are correct (i.e., check the formula and the math) and consistent with the approved work plan and applicable policies in the Corporate Reference Library.
- The Project Manager will be responsible for ensuring that data reduction is conducted in a manner that produces high quality data via review and approval of concepts, methods, assumptions, and calculations.

6.2 DATA VERIFICATION

All project decisions, conclusions, and recommendations will be based upon verified (validated) data. The purpose of data verification is to ensure that all data used for subsequent evaluations and calculations are scientifically valid, of known and documented quality, and legally defensible. Field data verification will be used to eliminate data not collected or documented in accordance with the protocols specified in the approved sampling plans. Laboratory data verification will be used to eliminate data not obtained using prescribed laboratory procedures.

The Project QA Manager and/or QC Manager will conduct a systems audit of field and laboratory documentation as necessary during the RI (see Section 10), in order to ensure that data is valid and usable. The following items will be reviewed to verify the data as applicable:

- Sampling procedures employed at site;
- Sample holding times;
- Documentation that the analytical results are within the control limits;
- Documentation that data and calculations were checked by the supervisor who was not involved in the performance of sampling, analysis, or data reduction;
- Documentation that a final review of the data was made by the laboratory manager for correctness and validity of the data;
- Calibration of methods and instruments;
- Routine instrument checks (noise levels, drift, linearity, etc.);
- Documentation on traceability of instrument standards, samples, and data;
- Documentation on analytical methodology and QC methodology;
- Results of performance audits with appropriate audit materials;
- The control for interference contaminants in analytical methods (use of reference blanks and check standards for method accuracy and precision);
- Documentation of routine maintenance activity to ensure analytical reliability;
- Documentation of sample preservation and transport; and
- Documentation of inventory control of chemicals and items used for testing (e.g., shelf life).

In addition, as appropriate, selected data packages may be validated following a procedure similar to EPA Functional Guidelines for validation of data under the Contract Laboratory Program (CLP). Note that CLP protocols have not been proposed; therefore, validation is only similar, not identical, to CLP. Given the desired detection limits, and the investigation level (RI), the protocols specified in this QAPP with the DQOs (Tables 3-2 to 3-5) are the most appropriate for this site.

6.3 REPORTING

6.3.1 Laboratory Report

At a minimum, the laboratory report will contain the following information for samples:

- Title and location of the project;
- Project identification number;
- Name of the report;
- Date report was prepared;
- Name, address, and telephone number of the subcontractor;
- Sample identification number;
- Name and location of sample;
- Type of sample (i.e., water, soil, or sediment);
- Date on which analysis was performed and date sample was prepared;
- Any special observations, circumstances, or comments relevant for interpretation of the data;
- Signature of the Laboratory QA Manager; and
- CLP-like deliverables where applicable. At a minimum, a Resource Conservation and Recovery Act (RCRA)-type data summary package will be generated.

Each parameter tested will include at a minimum, name of parameter, EPA or Ecology approved (or other) testing procedure references, results of analysis, and the units of the reported results.

6.3.2 Project Records

Project records will be maintained as follows:

- The Project Manager will be responsible for maintaining records in accordance with the requirements of this section until such time as those records are turned over to Rayonier for storage. All records will be accessible to Rayonier personnel until such time that they are turned over.

- The Project Manager will determine the records to be generated before the start of work.
- Field activity records, which will support the integrity of samples, will be entered in a bound notebook with numbered pages. Such records will be dated and signed or otherwise authenticated on the day of entry.
- Records retained on file will be indexed. The indexing system include, at a minimum, the location of records within the indexing system (which shall be in alphabetical, chronological, or numerical order, or as otherwise indicated in written procedures).
- There will be sufficient information in the records to permit identification between the record and the item(s) or activity to which it applies. Identification of records will be by means that permit traceability.
- The records storage system will provide for accurate retrieval of records without undue delay.

6.4 CORRECTION TO DOCUMENTATION

If an error is made during data reduction, analysis, or reporting, the error will be corrected by lining through the error so as not to obscure the original entry, entering the correct information, and initialing and dating the entry.

This page left intentionally blank.

7. QUALITY CONTROL PROCEDURES

7.1 QUALITY CONTROL CHECKS

The Laboratory QA Manager is responsible for planning, scheduling, and coordinating evaluations of the internal QC checks in accordance with approved laboratory procedures. The Laboratory QA Manager will be able to provide, upon request, to the QC Manager a satisfactory evaluation of the following:

- Possession and use of the latest approved Laboratory QA Plan, SOPs, standards and/or project specific instruction(s);
- Conformance with appropriate plans, procedures, standards, and instructions;
- Thoroughness of the performance;
- Identification and completeness of documentation generated during performance, including:
  - Project number and/or name
  - Task description
  - Name of performer
  - Date(s) of performance
  - Page number and total number of pages, if more than one sheet
  - Consideration of all blank titled spaces on forms
  - Legible and reproducible presentation
  - Reasonable data entries, calculations, and results
  - Precise plots, charts, data summaries, graphs, and clearly defined parameters
  - Proper approval, transcription, and reference of input data
- Analysis of performance evaluation (QA/QC) samples as appropriate.

7.2 ACCEPTANCE CRITERIA

The following acceptance criteria will be considered if pertinent to the specific activity:

- Appropriate forms, logs, or formats have been used;
- Equipment has been referenced and calibrated as required; and
- Equipment meets specifications.

Other acceptance criteria will be incorporated into the technical procedures that describe the performance and documentation of a specific activity.

7.3 ACCEPTANCE DOCUMENTATION

A verifier will indicate acceptance of all work performed as well as the resultant documentation by signing (or initialing) and dating the appropriate form or space provided. Provisions for checking will be incorporated into the SAPs as appropriate.

Differences between the verifier and work performer will be discussed and resolved. If agreement cannot be reached, the differences will be brought to the attention of succeeding higher levels of management until resolution is achieved.

7.4 CHECK FREQUENCY

Undocumented checks (surveillance) may be performed, as assigned, during the activity. A check of documentation will be performed at the completion of the task.

7.5 DOCUMENTATION OF CHECKS

The checking function will be documented in compliance with the applicable procedures for the specific task performed and retained for record purposes until project completion.

7.6 ANALYTICAL LABORATORY QC

The internal QC procedures will be described in the Laboratory QA Plan, together with associated SOPs. The laboratory QA manuals and SOPs must be provided upon request to the SMT by the QC Manager for review and approval for use on this project. Items that will be covered in these procedures and plans include:

- Matrix spikes
- Matrix spike duplicates

- Replicates
- Blanks (field, trip, method, reagent instrument, decontamination, and source water)
- Internal standards and surrogates
- Calibration and calibration verification
- Control charts
- Standards and standard sources
- Reagents and gases

7.7 FIELD SAMPLING QC

7.7.1 Field QC Samples

Field QC samples are identified in the SAP (Volume II). Field blanks will be used at the discretion of the QC Manager if there is a reason to suspect contamination introduced in the field. Following Ecology guidance, field spikes are not planned for the RI; however they remain an option for the QC Manager if unusual circumstances warrant their use. Replicate samples are planned for the RI; in general, they will be incorporated at a minimum frequency of 1 in every 20 samples and/or at an aggregate frequency of 5 percent.

7.7.2 Corrective Action

The FOLs occasionally may be required to adjust the sampling program to accommodate site-specific needs and to control quality. If it becomes necessary to modify field sampling as described in the SAP (Volume II), corrective action will be taken to ensure proper, approved procedures are implemented. Field change request forms will be completed as appropriate (Section 11.6). Such action might include the discarding and recollection of samples, or if samples have been sent for analysis, the laboratory may be contacted to terminate analysis. All corrective actions will be documented and reported immediately to the Technical Lead, QC Manager, or Project Manager.

7.7.3 Contamination

If sample results indicate contamination of field or trip blanks (detections above PQL), sampling and analysis may be performed again for the associated target analytes. The Project Manager, in conjunction with the QC Manager, will make this decision.

7.8 QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

QA/QC samples are necessary to ensure the precision, accuracy, representativeness, comparability, and completeness of the data. Four types of QA/QC samples will be processed: trip blank, field blank, field duplicate, and equipment rinsate (rinse blank). The field blank, field duplicate, and equipment rinsate are collected in the field, and the trip blank is provided by the analytical laboratory. In addition, other QA/QC samples will be evaluated at the discretion of the QC Manager to include blind duplicates, blind blanks, and blind spikes. Descriptions of these types of QA/QC samples are provided in the following sections.

7.8.1 Trip Blank

Trip blanks are samples that originate from analyte-free water taken from the laboratory to the sampling site and returned to the laboratory with the volatile organic compound (VOC) samples. One trip blank will accompany each cooler containing samples that will be submitted for VOC analysis. The trip blanks are used to assess the QA/QC of sample preservation, packing, shipping, and storage.

7.8.2 Source Water Blank

Source water blanks, which consist of the source water used in decontamination and cleaning, are collected and analyzed to determine the level of contamination introduced into the sample due to the sampling technique employed. One source water blank from each source of water will be collected and analyzed for the same parameters as the related samples.

7.8.3 Field Duplicate

For every 20 samples taken, one duplicate sample will be collected and submitted for laboratory analysis. The duplicate sample is designed to be identical to the original sample and is submitted to gain precision information on homogeneity, handling, shipping, storage and preparation, and analysis. Duplicate sampling is used to identify possible field variations. The duplicate sample will be collected at the same time and location as the environmental sample.

7.8.4 Equipment Rinsate

Equipment rinsates are the final analyte-free rinse water from equipment decontamination. These samples will be collected after the individual sampling event. The rinse blanks will be analyzed to ensure that decontamination procedures are sufficient, and that no cross-contamination occurred. To collect the equipment rinsate, deionized water will be poured through the cleaned equipment and collected into 1-liter amber glass bottles. The results from the rinse blanks will be used to flag or assess the levels of analytes in the samples. The rinsates will be analyzed for the same parameters as the related samples.

7.8.5 Other QA/QC Samples

Discretionary QA/QC samples include blind duplicates, blind blanks, and blind spikes. Blind duplicates are duplicate samples, preferably split from the same container, which are numbered by the same convention as the other samples so that the laboratory does not know they are duplicates. Similarly, blind blanks are samples of similar matrix to the field samples, known to be free of target contaminants. Blind blanks are also submitted to the laboratory using an identification scheme such that the laboratory does not know they are uncontaminated blanks. Blind spikes are field samples spiked to known concentrations of selected target analytes and submitted with the field samples to the laboratory using an identification scheme such that the laboratory does not know they are spiked samples. The use of field spikes is not recommended by Ecology (WDOE, Publication 91-16, 1991); therefore, field spikes are not planned for this project.

7.9 SPLIT SAMPLES

Split samples may be taken and sent to another laboratory for analysis in order to check the degree of variance introduced by the laboratory in analyzing the samples. If split sampling is required, the frequency and analysis and the name of the second laboratory shall be included in the SAPs. As an alternative, the duplicate sample can be used as a split sample; this determination will be made by the QC Manager, at the direction of the Project Manager.

7.10 CORRECTIVE ACTION

The FOLs occasionally may be required to adjust the sampling program to accommodate site-specific needs. If it becomes necessary to modify field sampling as described in the

SAPs, corrective action will be taken to ensure proper, approved procedures are implemented. If samples have been collected, these samples may be discarded and new samples taken. If samples have been sent for analysis, the laboratory may be contacted to terminate analysis. All corrective actions will be documented and reported immediately to the Technical Lead, QC Manager, QA Manager, or Project Manager.

7.11 CONTAMINATION

If sample results indicate contamination of field or trip blanks (detections above PQL), sampling and analysis may be performed again for the associated target analytes. The Project Manager, in conjunction with the QC Manager, will make this decision.

8. SYSTEMS AND PERFORMANCE AUDITS

8.1 SYSTEM AUDITS

At least one system audit of the analytical laboratory, field, and testing activities, and the QA program will be conducted during the RI. The systems audit will focus on the acceptability of project organization, staff, facilities, equipment, and methods. The audit will cover, in general, verification that approved procedures, a calibration program, and organization structure are in place and are used. The audit also will ensure that personnel responsibilities are clearly defined; a training program for personnel, chain-of-custody program, and records retention program are in place and are current; and corrective action of variances taken by laboratory and field personnel is responsive and timely. The audit will be conducted under the direction of the Project QA Manager and/or QC Manager, by their staff members, or by an independent third party.

8.1.1 Analytical Laboratories

Internal system audits will be performed by the Laboratory QA Manager, as described in the Operations Procedures Manual of the laboratory. Systems audits involve laboratory comparison of project performance (as documented by protocols and procedures) to validate data. Results of the audits will be retained as a project record and made available to the Foster Wheeler Environmental QA Manager and/or QC Manager on request for use during the laboratory systems audit.

8.1.2 Field Sampling

After field systems are operational, the Project QA Manager or designee will conduct at least one technical systems audit of field sampling, covering the following:

- Organization and responsibilities to determine whether the QA organization is operational;
- The collection of samples to ensure that written procedures are available and are being followed;
- Chain-of-custody program to ensure that the appropriate steps have been followed in the traceability of sample origin;

- The implementation of the operational procedures to ensure that the appropriate QC checks are being made in the field and records are maintained of these checks;
- Determination of whether the specified equipment is available, calibrated, and in proper working order;
- Technical training to ensure that sampling crews are adequately trained;
- Records to ensure that recordkeeping procedures are operational and that field notebooks, logsheets, bench sheets, and tracking forms are properly prepared and maintained;
- Corrective action to verify that the appropriate chain-of-command is followed in responding to variances.

Audit reports will be sent to the Foster Wheeler Environmental Project Manager and will be retained as a project record.

8.2 SURVEILLANCE

8.2.1 Constant Surveillance

Constant surveillance of field sampling and testing activities will be performed by the FOLs as approved by the Technical Leads and Project Manager.

8.2.2 Periodic Surveillance by Laboratories

Laboratory activities, which are subject to periodic review by internal laboratory QC personnel, include the following:

- Review and approval of the Laboratory QA Plan
- Parameter and/or laboratory notebooks
- Instrument logs
- Sample log-in, dispensing, and labeling for analysis
- Updating of QC criteria for spike recoveries
- Final approval of data from each sample lot (field group)
- Control of chemicals with limited shelf life

These periodic surveillance activities will be conducted as described in the Laboratory QA Plan.

8.2.3 On-Site Periodic Surveillance

The FOLs or designee will perform periodic surveillance during the performance of field activities. Results of each surveillance will be recorded in the site logbook.

Acceptance of services performed will be documented by the FOLs signing and dating the appropriate documents, including forms, logs, maps, charts, drawings, test results, checklists, computer printouts, test evaluations, and receipts.

8.3 PERFORMANCE AUDITS

Performance audits evaluate the actual performance of a laboratory. Audits are conducted periodically to determine the accuracy of the total measurement system(s) or parts thereof, typically against known Performance Evaluation (PE) standards. These standards can be blind PEs, provided by Foster Wheeler Environmental or external third party, or known internal standards such as surrogates or matrix spikes. Blind PEs will be submitted at the discretion of the QC Manager. The source of these PEs may include NIST, or other third-party vendors. In addition, the use of state accredited laboratories will ensure that performance audits have been previously conducted and passed by these subcontractors.

8.4 RESOLUTION OF DISCREPANCIES

If there are any discrepancies, deficiencies, or indeterminate results in the field or laboratory, the individual who discovers the discrepancy will take the necessary action to require appropriate corrective actions. If resolution cannot be reached immediately, the individual will bring the problems to the attention of the Project Manager, QA Manager, or QC Manager to initiate corrective action. If the problem cannot be rectified to the satisfaction of all concerned, the QA Manager will stop work until the situation is resolved.

The QA Manager will evaluate the problems, provide direction, and verify implementation of solutions before allowing the activity to resume. Specifically, the following procedures will be implemented:

- Bench technicians will verify that the Laboratory Information Management Systems (LIMS) output is correct, and follow the SOP if output is found to be out of compliance.

- Laboratory supervisors (or equivalent) will review all preliminary reports and submit any discrepancies to the Bench Technician for review and possible corrections following the SOP.
- Foster Wheeler Environmental QC Manager (or designated staff) will review all preliminary and final reports, and if obvious errors or discrepancies are identified, the QC Manager will contact the laboratory and direct corrective actions.

9. PREVENTIVE MAINTENANCE

The objective of the preventive maintenance program for sampling and analytical equipment is to avoid generating spurious environmental measurements that could lead to inappropriate remedial responses. The preventive maintenance program for field equipment is described in detail in the SOPs (SAP Appendices, Volume II) and associated manufacturer's equipment manuals.

9.1 SAMPLING AND ANALYTICAL EQUIPMENT

Field sampling, health and safety monitoring, and analytical equipment affecting project data will be kept in good working order. The maintenance procedures for this equipment will be approved for use by the responsible organization. Records of equipment maintenance will be maintained by the FOLs in the instrument logbook. If leased, maintenance records must be kept by the vendor and made available upon request. Maintenance schedules must be conducted in accordance with the SOPs (SAP Appendices), and documented in the instrument logbook.

9.2 SUPPORT EQUIPMENT

Support equipment should be periodically inspected for preventive maintenance purposes to ensure that performance standards are maintained for proper and efficient execution of all tasks and responsibilities. Support equipment is defined as all equipment not previously discussed that will at some point be required for completing an environmental monitoring or measurement task. This equipment may include storage and transportation containers, Global Positioning System (GPS), cameras, and communications gear.

9.3 LABORATORY PREVENTIVE MAINTENANCE

Laboratory preventive maintenance will be implemented in accordance with the Laboratory QA Plan and associated SOPs. At a minimum, all major instrumentation will have associated records and logbooks, including schedules and criteria for maintenance.

This page left intentionally blank.

10. DATA ASSESSMENT PROCEDURES

10.1 DEFINITION OF TERMS

Samples: A group of units or portion of material taken from a larger collection of units or quantity of material, which serves to provide information that can be used as a basis for judging the quality of the larger quantity of material as a basis for action on the larger quantity.

Data Quality: The totality of features and characteristics that bear on the ability of data to satisfy a given purpose. The characteristics of major importance are precision, accuracy, representativeness, completeness, and comparability (PARCC).

PARCC Parameters: The PARCC parameters are defined in Section 5.

10.2 FIELD WORK

Field sampling consists of a single collection cycle in the field for subsequent chemical analysis in an analytical laboratory. There may be no opportunity to make routine assessments of accuracy, precision, or completeness in the course of the field sampling. QA/QC samples, as described in Section 6, will be included to assess field work.

10.3 LABORATORY ANALYSIS

The laboratory compiles information regarding the precision, accuracy, and completeness of data. DQO requirements are presented in Tables 3-1 to 3-5. The methods for making these assessments will be prescribed in the approved QAAP or SOPs of the analytical laboratory. These procedures will specify the processing of blanks, replicates, and spikes. Surrogate standards are used with each sample analyzed by gas chromatography/mass spectrography. Additionally, the laboratory will monitor their QC data to ensure that they are within the established control limits for the methods, as published by EPA or state agency.

Data accuracy and precision will be assessed for each sample lot using samples and sample duplicates spiked at a known level. Completeness will be reported. The descriptive calculations are defined in Section 5.

10.4 PROCEDURE VALIDATION

When new laboratory analytical methods are developed, the data necessary to characterize the method must be submitted to the QC Manager prior to implementation. These data will include the associated SOPs and results from MDL studies, results of matrix spike and matrix spike duplicate tests (for accuracy and precision specifications), and other information sufficient to develop appropriate data quality objectives (e.g., surrogate recoveries, known interferences, and instrument specifications).

10.5 REVIEW OF DATA/DATA QUALITY ASSESSMENT

When sample analysis data are received from the analytical laboratory, they will undergo a QA review by the QC Manager, and the accuracy and precision achieved will be compared to the control limits.

The control limits are presented in Tables 3-2 to 3-5, and represent typical results from previous EPA method development studies. Calculations will follow standard statistical conventions and formulas as presented in Section 5. Additional specifications and professional judgment by the QC Manager may be incorporated when data from specific matrices and field samples are available.

As a final step, a data quality assessment will be prepared to document the overall quality of the data in terms of the project-specific data quality objectives and the overall effectiveness of the data generation process. This includes evaluation of the overall measurement system in terms of completeness of project plans, effectiveness of field measurement and data collection techniques, and the relevance of laboratory analytical methods used for the project. The major components of the data quality assessment are presented below and show the logical progression of the process:

- *Data Validation Summary.* Summarizes the individual data validation reports for all sample delivery groups by analytical method. The summary presents systematic problems, data generation trends, general conditions of the data, and reasons for data qualification.
- *Quality Control Sample Evaluation.* Evaluates the potential contamination introduced into the samples via the analysis of control samples.
- *Assessment of Data Quality Objectives.* An assessment of the quality of data measured and generated in terms of accuracy, precision, and completeness through

the evaluation of laboratory and field control samples in relation to objectives established for the project.

- *Summary of Data Usability*. This section of the assessment summarizes the usability of data, based upon the assessment performed in the three preceding steps. Sample results for each analytical method will be qualified as acceptable, rejected, estimated, biased high, or biased low.

The data quality assessment will help to achieve an acceptable level of confidence in the decisions that are to be made based upon the project data.

This page left intentionally blank.

11. CORRECTIVE ACTION

11.1 NONCONFORMANCE REPORT

The Project QA Manager will issue a Nonconformance Report (NCR) for each nonconforming condition identified (e.g., when overall objectives for precision, accuracy, completeness, representativeness, or comparability are not satisfied), or when unacceptable procedural practices or conditions are identified. (An NCR is typically not issued for qualified data as a result of validation or review unless significant data are rejected [typically qualified with an "R" flag]). An NCR form is provided in Figure 11-1. The Laboratory QA Manager will issue NCRs concerning laboratory performance and will make them available to the Project QA Manager and QC Manager.

The NCR will fully describe the conditions requiring corrective action, indicate the nature of the corrections required, and specify a schedule for compliance. The final authority for issuance of an NCR rests with the QA Manager who will notify the Project Manager. The NCR will indicate closure as noted below (Section 13.2).

11.2 CORRECTIVE ACTION

Upon the issuance of an NCR by Foster Wheeler Environmental, it will be delivered to the Laboratory QA Manager, the Project Manager, and/or subcontractor involved. The NCR will provide space for the responsible individual to indicate the nature of the corrective action taken and will require appropriate documentation of such action. The corrective action taken will include measures to preclude a repetition of the original deficiency. After the NCR has been reviewed and the corrective action is acceptable, the Project QA Manager, QC Manager, and the Laboratory QA Manager (if applicable) will sign the NCR to this effect and provide documentation to the specified parties that the NCR has been satisfactorily resolved.

11.3 STOP-WORK ORDER

If corrective actions are insufficient, if resolution cannot be reached, or if results of prior work are indeterminate, work may be stopped by a Stop-Work Order. The Stop-Work Order can only be authorized by the Project Manager or Project QA Manager in writing. If

Figure 11-1. NCR Form

NONCONFORMANCE REPORT

Client		NCR No.	
Project		Date	
Responsible Contractor			
Applicable Daily Report			
Drawing No./Specification No.			
1. Description of Nonconforming Component			
Name & Signature	Title/Company	Date	
2. Recommended Disposition & Corrective Action			
Name & Signature	Title/Company	Date	
3. Review of Recommended Disposition and Corrective Action Accepted _____ Rejected _____ Accepted with Comments _____			
Verification of Disposition and Corrective Action Required _____ Not Required _____			
By (Signature)	Title	Date	
4. Inspector Acceptance	Date	Project QA Manager Acceptance	Date
5. Distribution			
Laboratory QA Manager			
QC Manager			
Project Manager			

there is a disagreement between the QA Manager and the Project Manager, the differences will be brought to the attention of succeeding levels of management until resolution is achieved. The Stop-Work Order will remain in effect until the problem is satisfactorily resolved in the judgment of the responsible parties noted above. The Stop-Work Order will apply only to affected tasks, and not necessarily to the entire project.

11.4 STOP-WORK CORRECTIVE ACTION

The conditions for which the Stop-Work Order was issued will be described in sufficient detail to allow proper evaluation of the problems and to effect proper corrective action. Documentation of discussions, telephone conversations, or correspondence that describe the actions taken to evaluate the problems, provide solutions, and verify implementation of solutions will be attached to the Stop-Work Order and fully referenced in the appropriate spaces. Work will not continue until the Stop-Work Order has been rescinded by the individual that authorized the Stop-Work Order. The Project Manager (or designee) must be notified within 48 hours of a Stop-Work Order.

11.5 CAUSE AND ACTION TO PREVENT RECURRENCE

The QA Manager will track the NCRs, analyze the corrective actions required, and take the necessary steps to resolve the causes of the nonconforming conditions to prevent recurrence.

11.6 FIELD CHANGE

The Project Manager or his designee is responsible for all site activities. In this role the Project Manager at times might be required to adjust the site programs to accommodate site-specific needs. When it becomes necessary to modify a program, the responsible Site Manager notifies the Project Manager and Project QA Manager of the anticipated change and implements the necessary changes. Rayonier, Ecology, and the Tribe will be notified as appropriate. When a change is determined to be necessary, a written notification will be submitted by the initiator on a Field Change Request (FCR) form, as described in the SAP (Volume II). If unacceptable, the action taken during the period of deviation will be evaluated in order to determine the significance of any departure from established program practices and appropriate action taken.

The substantive changes in the program, which are documented on a FCR form, must be signed by the initiator, Project QA Manager, QC Manager (as appropriate), Project

Manager, or their designees. Minor changes require only the signatures of Foster Wheeler Environmental staff. Field changes that do not affect the end use of the data, or other QA parameters will be handled within Foster Wheeler Environmental. Changes that significantly affect the PARCC should be approved by all QAPP signatories. A typical FCR Form used to document field changes is provided in the SAP (Volume II). The FCRs for each document will be numbered sequentially starting with the number 001.

The Project Manager is responsible for controlling, tracking, and implementing the identified changes. Completed FCRs, at a minimum, will be distributed to the Project Manager, Technical Leads, Foster Wheeler Environmental Project QA Manager, and the QC Manager.

11.7 OTHER CORRECTIVE ACTIONS

11.7.1 Laboratory Quality Control Samples

If laboratory QC samples are outside of specified control limits as established in Tables 3-2 to 3-5, or as specified by the methods or implementing SOPs, the associated data will be flagged, following general EPA guidance and conventions. These data will be reviewed and/or validated by the QC Manager (or designee). Based on professional judgment, the data will be determined to be usable or not usable for intended purposes. If judged not usable, the QC Manager will notify the Project Manager, and the decision for resampling/reanalysis will be determined on a case-by-case basis, depending on the needs for and uses of the particular data sets in question.

11.7.2 Performance and Systems Audits

If the performance or system audits identify deficiencies, these deficiencies will be documented in the audit report. In addition, a recommended list of corrective action items will be developed, specific to the auditor's findings, observations, and comments. The project technical staff will be solicited for input, as required, depending on the nature and extent of the finding. A copy of the audit report will be provided to the Project Manager. These items, depending upon the level of deficiency, will require follow-up by the responsible parties and approved and closed by the auditor and Project QA Manager.

.

12. QUALITY ASSURANCE REPORTS

12.1 FREQUENCY

During periods of field and laboratory activities, the Project QA Manager and QC Manager will provide QA status reports (typically verbal) at appropriate intervals to the Project Manager regarding the performance of the QA Program. These reports will include any laboratory reports furnished by the Laboratory QA Manager. Potential problems that might arise may be identified to the program management at any time. At least one summary written report will be prepared for the management record.

12.2 CONTENTS

The report(s) to management will contain the following:

- Results of any system or performance audits conducted during the period;
- An assessment of the PARCC of measurement data;
- A listing of any NCRs issued during the period, related corrective actions undertaken, and an assessment of the results of these actions;
- Identification of significant QA problems and recommended solutions; and
- Documentation of closure of any NCRs and corrective actions completed.

This page left intentionally blank.

13. REFERENCES

American Public Health Association (APHA), American Water Works Association (AWWA), Water Environment Federation (WEF). 1995. *Standard Methods for the Examination of Water and Wastewater, 19th Edition*, M.A. Franson, Mgn. Ed., American Public Health Association, Washington, D.C.

ASTM (American Society for Testing and Materials). 1995. *1995 Annual Book of ASTM Standards, Section 11 - Water and Environmental Technology*, Vols. 11.01-11.05, American Society for Testing and Materials, Philadelphia, Pennsylvania.

ASTM. 1996. Annual Book of ASTM Standards. Section 11 Water and Environmental Toxicology, Volume 11.05 Biological Effects and Environmental Fate; Biotechnology; Pesticides.

AOAC International. 1995. *Official Methods of Analysis of AOAC International, 16th Edition*, Patricia Cunniff, Ed. AOAC International, Arlington, Virginia.

Bragdon-Cook, K. 1995. *Review of New Scientific Information for SMS Rule Triennial Review: Sediment Management Standards Detection Limits*. Washington State Department of Ecology, Olympia, WA.

Ecology. 1995. *Sediment Sampling and Analysis Plan Appendix (to SCUM1 and SCUM2*). Prepared for Ecology, Sediment Management Unit, Olympia, WA. PTI Environmental Services, Bellevue, WA. This document is currently under review and has not been published.

Ecology. 1991a. *Guidelines and Specifications for Preparing Quality Assurance Project Plans.* Publication 91-16, Ecology Environmental Investigations and Laboratory Services Program, Quality Assurance Section, Manchester, Washington.

Ecology. 1991b. *Sediment Cleanup Standards User Manual (SCUM2).* Washington State Department of Ecology, Sediment Management Unit, Olympia, WA.

Freund, J.E. 1973. *Modern Elementary Statistics.* Fourth Edition. Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

PSEP (Puget Sound Estuary Program). 1997. *Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound*. Prepared by Washington Department of Ecology, Olympia, Washington for EPA, Region 10, Office of Puget Sound, Seattle, WA. April 1997.

PSEP. 1996a. *Recommended Guidelines for Measuring Organic Compounds in Puget Sound Water, Sediment and Tissue Samples.* Organics chapter. Prepared for U.S. Environmental Protection Agency (Region 10) and Puget Sound Water Quality Authority.

PSEP. 1996b. *Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment and Tissue Samples.* Metals chapter. Prepared for U.S. Environmental Protection Agency (Region 10) and Puget Sound Water Quality Authority.

PSEP. 1996c. *Recommended Quality Assurance and Quality Control Guidelines for the Collection of Environmental Data in Puget Sound.* QA/QC chapter. Prepared for U.S. Environmental Protection Agency (Region 10) and Puget Sound Water Quality Authority.

EPA (U.S. Environmental Protection Agency). 1998. *Rayonier Pulp Mill Expanded Site Inspection, TDD: 97-06-0010.* Region 10, Superfund Technical Assessment and Response Team, Seattle, WA. October 1998.

EPA. 1996a. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, (SW-846) Third Edition (through Final Update IIB)* U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C.

EPA. 1996b. *Inorganic Arsenic in Water by Hydride Generation Quartz Furnace Atomic Absorption*. Method 1638. U.S. Environmental Protection Agency, Office of Water, Engineering and Analysis Division (4303). July 1996.

EPA. 1996c. *Determination of Trace Elements in Ambient Waters by Inductively Coupled Plasma – Mass Spectrometry*. Method 1638. U.S. Environmental Protection Agency, Office of Water, Engineering and Analysis Division (4303). January 1996.

EPA. 1994a. *Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution HRGC/HRMS*. Method 1613, Revision B. U.S. Environmental Protection Agency, Office of Water, Engineering and Analysis Division (4303). October 1994.

EPA. 1993a. *Data Quality Objectives Process for Superfund, Interim Final Guidance.* EPA/540-R-93-071. Office of Solid Waste and Emergency Response, Washington, D.C.

EPA. 1994b. *EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review.* EPA 540/R-94-013. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C.

EPA. 1993b. *EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review.* EPA 540/R-94-012. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington D.C.

EPA. 1991. Analytical Method for Determination of Acid Volatile Sulfide and Selected Simultaneously Extractable Metals in Sediment. Office of Science and Technology, Health and Ecological Criteria Division, Washington, D.C. EPA 821/12-91/100.

EPA. 1989. *Guidance on Conducting Remedial Investigations and Feasibility Studies Under CERCLA*. EPA/540/6-89/004. Office of Solid Waste and Emergency Response, Washington, D.C.

EPA. 1984. *Technical Additional to Methods for Chemical Analysis of Water and Wastes.* EPA 600/4-84-017. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C.

EPA. 1983. *Methods for Chemical Analysis of Water and Wastes.* EPA-600/4-79-020. U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, OH. Rev. March 1983.

EPA. 1982a. *Technical Additions to Methods for Chemical Analysis of Water and Wastes.* EPA 600/4/82-055.

EPA. 1982b. *Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater.* EPA 600/4-82-057.

EPA. 1980. *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans.* EPA/QAMS/005/80. Office of Solid Waste and Emergency Response, Washington, D.C.

EPA. 1978. *NEIC Policies and Procedures.* EPA/330/9-78/00IR. Office of Solid Waste and Emergency Response, Washington, D.C.

Ecology (Washington State Department of Ecology). 1997. *Analytical Methods for Petroleum Hydrocarbons*. Publication No. ECY 97-602. June 1997.

Zar, J.H. 1974. *Biostatistical Analysis.* Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

.

APPENDIX A

LABORATORY QA PLAN
(Under Separate Cover)

This page left intentionally blank.